PICKER

System Operator's Guide

Clinix VP4

DRS No.
TX008:F

Part No.
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Diagnostic X-ray Systems

MECHANICAL - ELECTRICAL WARNING

ALL OF THE MOVEABLE ASSEMBLIES AND PARTS OF THIS EQUIPMENT SHOULD BE OPERATED WITH CARE AND ROUTINELY INSPECTED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS CONTAINED IN THE EQUIPMENT MANUALS.

ONLY PROPERLY TRAINED AND QUALIFIED PERSONNEL SHOULD BE PERMITTED ACCESS TO ANY INTERNAL PARTS. LIVE ELECTRICAL TERMINALS ARE DEADLY; BE SURE LINE DISCONNECT SWITCHES ARE OPENED AND OTHER APPROPRIATE PRECAUTIONS ARE TAKEN BEFORE OPENING ACCESS DOORS, REMOVING ENCLOSURE PANELS, OR ATTACHING ACCESSORIES.

DO NOT REMOVE FLEXIBLE HIGH TENSION CABLES FROM X-RAY TUBE HOUSING OR HIGH TENSION GENERATOR AND/OR ACCESS COVERS FROM GENERATOR UNTIL THE MAIN AND AUXILIARY POWER SUPPLIES HAVE BEEN DISCONNECTED.

FAILURE TO COMPLY WITH THE FOREGOING MAY RESULT IN SERIOUS OR FATAL BODILY INJURIES TO THE OPERATOR OR THOSE IN THE AREA.

ELECTRICAL GROUNDING INSTRUCTIONS

THE EQUIPMENT MUST BE GROUNDED TO AN EARTH GROUND BY A SEPARATE CONDUCTOR. THE NEUTRAL SIDE OF THE LINE IS NOT TO BE CONSIDERED THE EARTH GROUND. ON EQUIPMENT PROVIDED WITH A LINE CORD, THE EQUIPMENT MUST BE CONNECTED TO A PROPERLY GROUNDED, THREE-PIN RECEPTACLE. DO NOT USE A THREE-TO-TWO PIN ADAPTER.

INSTALLATION AND ENVIRONMENT

EXCEPT FOR INSTALLATIONS REQUIRING CERTIFICATION BY THE MANUFACTURER PER FEDERAL STANDARDS, SEE THAT A RADIATION PROTECTION SURVEY IS MADE BY A QUALIFIED EXPERT IN ACCORDANCE WITH NCRP 102, SECTION 7, AS REVISED OR REPLACED IN THE FUTURE. PERFORM A SURVEY AFTER EVERY CHANGE IN EQUIPMENT, WORKLOAD, OR OPERATING CONDITIONS WHICH MIGHT SIGNIFICANTLY INCREASE THE PROBABILITY OF PERSONS RECEIVING MORE THAN THE MAXIMUM PERMISSIBLE DOSE EQUIVALENT.

Diagnostic X-ray Systems

RADIATION WARNING

X-RAY AND GAMMA-RAYS ARE DANGEROUS TO BOTH OPERATOR AND OTHERS IN THE VICINITY UNLESS ESTABLISHED SAFE EXPOSURE PROCEDURES ARE STRICTLY OBSERVED.

THE USEFUL AND SCATTERED BEAMS CAN PRODUCE SERIOUS OR FATAL BODILY INJURIES TO ANY PERSONS IN THE SURROUNDING AREA IF USED BY AN UNSKILLED OPERATOR. ADEQUATE PRECAUTIONS MUST ALWAYS BE TAKEN TO AVOID EXPOSURE TO THE USEFUL BEAM, AS WELL AS TO SCATTERED RADIATION RESULTING FROM THE PASSAGE OF RADIATION THROUGH MATTER.

THOSE AUTHORIZED TO OPERATE, PARTICIPATE IN, OR SUPERVISE THE OPERATION OF THE EQUIPMENT MUST BE THOROUGHLY FAMILIAR AND COMPLY COMPLETELY WITH THE CURRENT ESTABLISHED SAFE EXPOSURE FACTORS AND PROCEDURES DESCRIBED IN PUBLICATIONS, SUCH AS: SUBCHAPTER J OF TITLE 21 OF THE CODE OF FEDERAL REGULATIONS, "DIAGNOSTIC X-RAY SYSTEMS AND THEIR MAJOR COMPONENTS," AND THE NATIONAL COUNCIL ON RADIATION PROTECTION (NCRP) NO. 102, "MEDICAL X-RAY AND GAMMA-RAY PROTECTION FOR ENERGIES UP TO 10 MEV-EQUIPMENT DESIGN AND USE," AS REVISED OR REPLACED IN THE FUTURE.

THOSE RESPONSIBLE FOR THE PLANNING OF X-RAY AND GAMMA-RAY EQUIPMENT INSTALLATIONS MUST BE THOROUGHLY FAMILIAR AND COMPLY COMPLETELY WITH NCRP NO. 49, "STRUCTURAL SHIELDING DESIGN AND EVALUATION FOR MEDICAL OF X-RAYS AND GAMMA-RAYS OF ENERGIES UP TO 10 MEV," AS REVISED OR REPLACED IN THE FUTURE.

FAILURE TO OBSERVE THESE WARNINGS MAY CAUSE SERIOUS OR FATAL BODILY INJURIES TO THE OPERATOR OR THOSE IN THE AREA.

TO THE USER OF THIS MANUAL

THE USER OF THIS MANUAL IS DIRECTED TO READ AND CAREFULLY REVIEW THE INSTRUCTIONS, WARNINGS AND CAUTIONS CONTAINED HEREIN PRIOR TO BEGINNING INSTALLATION OR SERVICE ACTIVITIES. WHILE YOU MAY HAVE PREVIOUSLY INSTALLED OR SERVICED EQUIPMENT SIMILAR TO THAT DESCRIBED IN THIS MANUAL, CHANGES IN DESIGN, MANUFACTURE OR PROCEDURE MAY HAVE OCCURRED WHICH SIGNIFICANTLY AFFECT THE PRESENT INSTALLATION OR SERVICE.

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EQUIPMENT DESCRIPTION

INTRODUCTION

The purpose of this manual is to provide information on the description, operation and operator maintenance of the Clinix VP4 x-ray system.

This section provides a basic description of the Clinix VP4 x-ray system delineating the major components and briefly identifies the function of each component and the interrelations to other components as appropriate. In addition to major components, optional components are also identified and briefly described. This section also contains the mechanical and electrical specifications.

DESCRIPTION

SYSTEM

The Clinix VP4 x-ray system consists of six major components as shown in **Figure 1–1** and listed as follows:

1. Table
2. Tubestand
3. Control Arm
4. Collimator
5. Bucky
6. Generator Control Panel

All control elements on the control arm, the tube column, collimator, and bucky are easily accessible from the front of the table. All major components are described individually in the paragraphs that follow.

TABLE

The table of the Clinix VP4 x-ray system provides the mounting for all system components except for the generator control panel. The table is equipped with a longitudinally mobile, electronically controlled bucky unit that houses film cassettes.

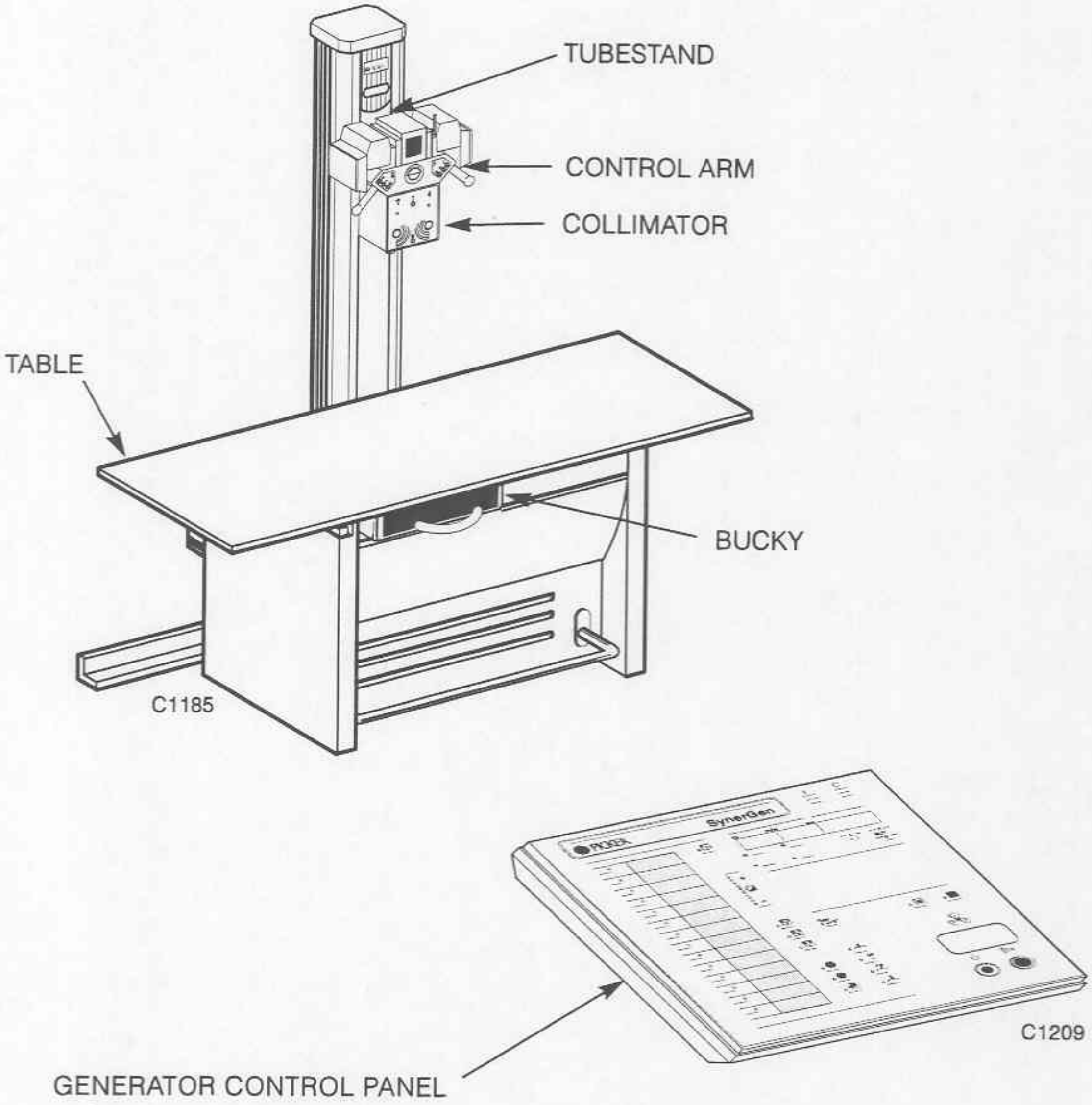

TUBESTAND
CONTROL ARM
COLLIMATOR
TABLE
BUCKY
C1185
SynerGen
C1209
GENERATOR CONTROL PANEL

FIGURE 1–1 CLINIX VP4 MAJOR COMPONENTS

The floating, flat tabletop is locked in place in the longitudinal and transverse directions by highly effective, foot-operated mechanical brakes. Movement in both directions is accomplished by means of a conveniently placed brake release pedal bar. The easy floating motion of the tabletop and its wide range of displacement ensure convenient patient positioning. The table contains two rails that mount the movable tube column.

TUBESTAND

The tubestand is mounted to the rear of the table on two rails that allow longitudinal movement of the tubestand. The tube stand provides support and counterballance of the control arm (x-ray tube and controls) and collimator. All movements of the tube column and x-ray tube unit are virtually effortless, and can be locked in place.

CONTROL ARM

The control arm provides a means for easy movement of the x-ray tube and collimator. It provides for movement in both the longitudinal and transverse directions and also provides for rotational movement. It also provides the mounting for the collimator and houses some of the controls and indicators of the entire system. The rotation about its axis has an automatic detent at 90° for alignment with lateral cassette holder accessory.

With the lock handle released, the x-ray tube unit can be manually swiveled within its trunnions, 30° to the front and 20° to the rear. The vertical column on its base can be manually rotated ±90°, with detents at +90° and -90°.

COLLIMATOR

The collimator of the Clinix VP4 x-ray system is an automatic x-ray beam collimator that mounts to the control arm. It automatically controls the x-ray field size to equal the film size in the cassette. This is accomplished with two pairs of lead shutters which are motor driven within the collimator. One motor driving the transverse shutter pair and one motor driving the longitudinal shutter pair.

A high intensity lamp is incorporated to provide field illumination. The lamp projects a visible center mark that corresponds to the center of the x-ray beam which provides a direct visualization of the area targeted for the x-ray image.

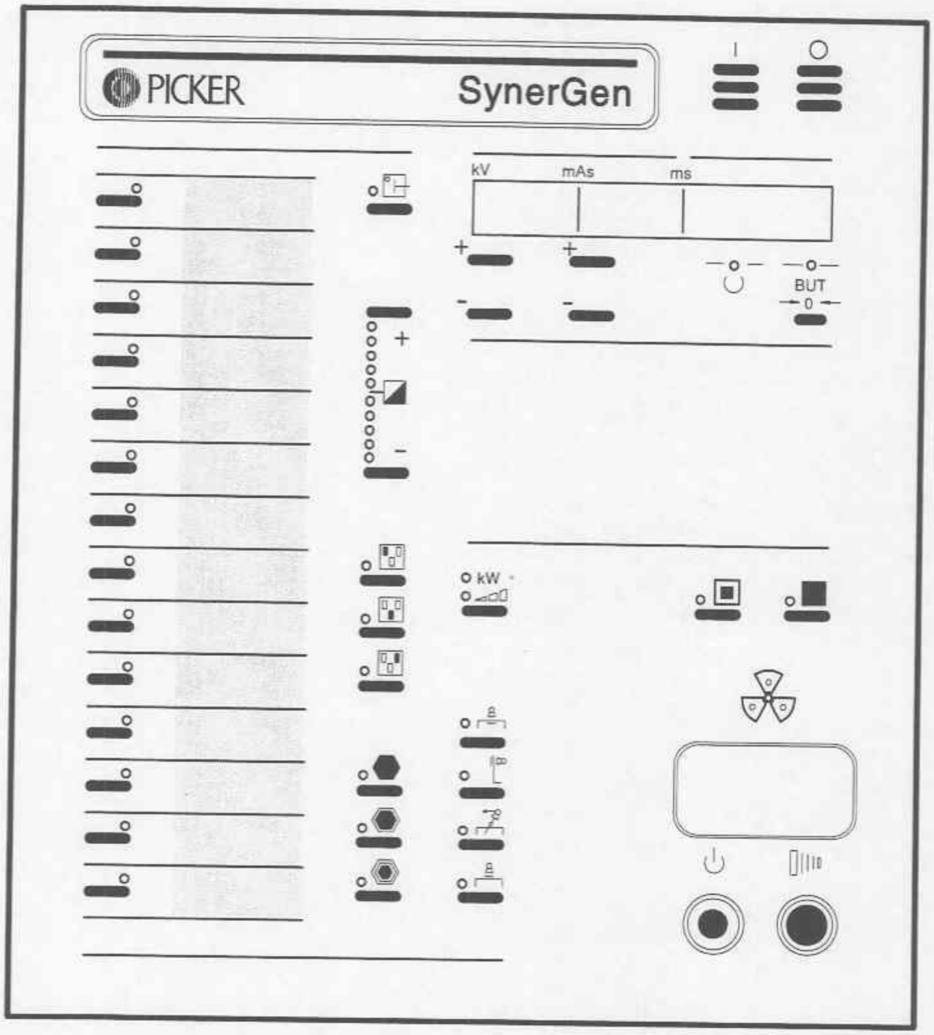
BUCKY

The bucky of the Clinix VP4 x-ray system is longitudinally mobile and electronically controlled. It is used for manual cassette loading and includes cassette size-sensing for automatic collimation, complete with grid and three-field pickup for operation with Automatic Exposure Control (AEC).

GENERATOR

The Clinix VP4 generator is a microprocessor-controlled inverter/x-ray generator with a capacity of 40 kW and is mounted inside the table. The generator is designed for all routine radiographic diagnostic applications. Anatomically Programmed Radiography (APR) control is included. If required, the APR (such as AEC parameters, kV, and mAs) can be changed manually for varying applications by overriding the default settings using the keys on the generator control panel.

The control panel, shown in **Figure 1–2** provides the user with a convenient method of controlling the functions of the Clinix VP4 x-ray system. All available controls are present on the control panel and are described in detail in the section entitled **CONTROLS AND INDICATORS** later in this manual.


PICKER
SynerGen
I
O
kV
mAs
ms
+
+
-
-
BUT
0
kW

C1210

FIGURE 1–2 CLINIX VP4 GENERATOR CONTROL PANEL

FEATURES

- Microprocessor-controlled x-ray generator installed inside the table.
- Wide range of applications.
- High reliability.
- Short table-to-wall distance promotes efficient use of space. Table height provides convenient patient access.
- Floating, flat tabletop of carbon fiber combines low attenuation with high rigidity.
- Short tabletop-to-film distance.
- Wide range of tabletop travel for convenient patient positioning.
- Clearly marked tabletop centerline.
- Convenient low-profile lateral accessory rails for accessory attachment.
- Cassette size-sensing bucky fim tray.
- Safety coupling for automatic centering of X-ray tube unit to bucky unit.
- Extensive cassette program, 5" x 7" through 14" x 17".
- Controls are arranged for easy access and operation on the control arm.
- Angle indicator ensures reproducible angulation positions of x-ray tube (rotation about the support arm axis).
- 253 mm to 1775 mm vertical travel range of focal spot.
- Electromagnetic brakes for longitudinal travel of tubestand, vertical and transverse travel of tube unit, and angulation of x-ray tube unit (rotation about horizontal support arm axis, with additional 90° detents).
- With the lock handle released, the x-ray tube unit can be manually swiveled within its trunnions, 30° to the front and 20° to the rear.
- The tubestand can be manually rotated ±90°, with detents at 90°.

ACCESSORIES

There are three accessories available with the Clinix VP4 x-ray system. These accessories are illustrated and described in the paragraphs that follow.

COMPRESSION DEVICE

The compression device attaches to the tabletop accessory rails and is shown in **Figure 1–3**. The transparent compression band can be used to compress or immobilize the body part under examination. The device is self-locking.

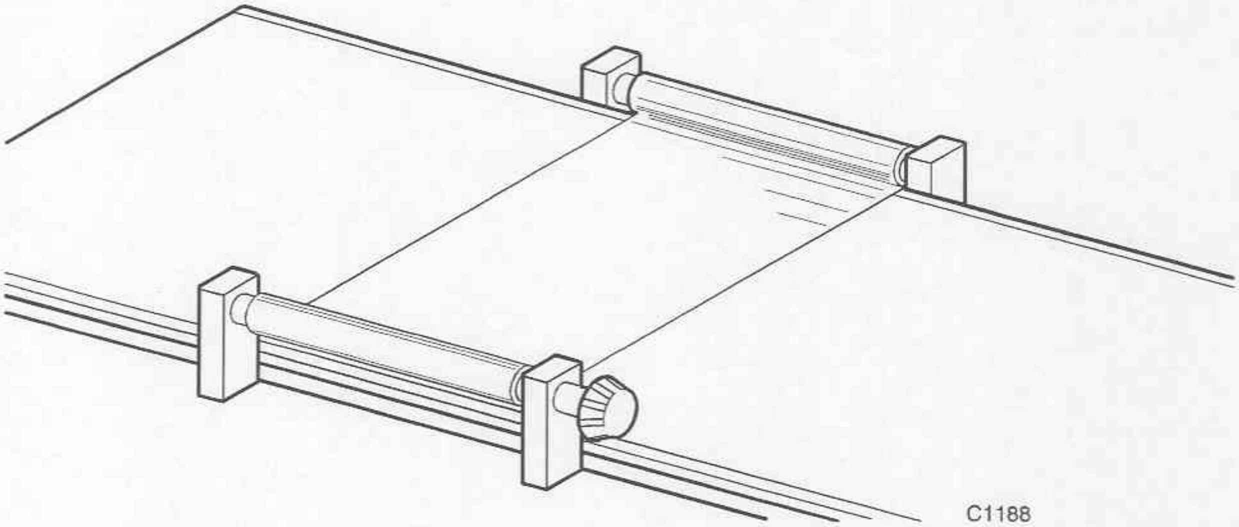


FIGURE 1–3 COMPRESSION DEVICE

HAND GRIPS

The hand grips are shown in **Figure 1–4**. These make the patient feel more secure while the tabletop is being moved. The hand grips are inserted into the tabletop accessory rails.

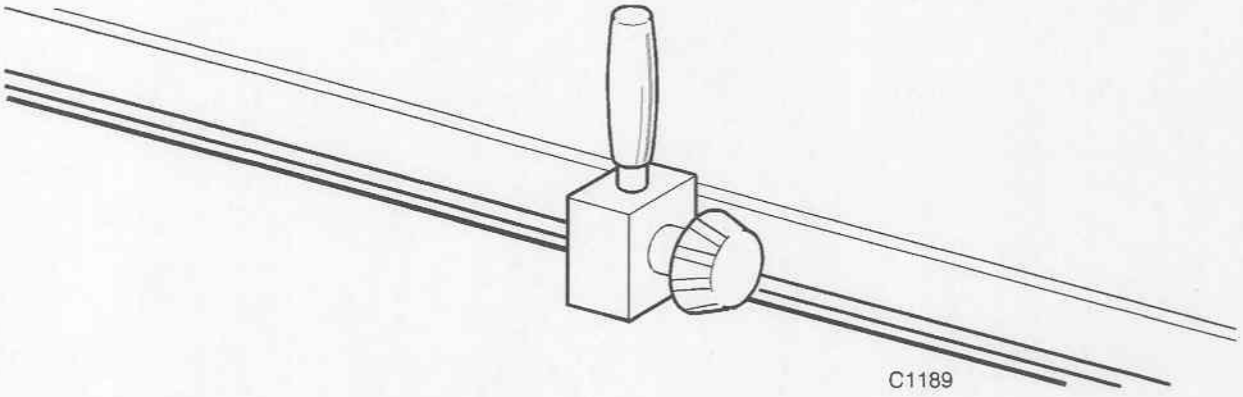


FIGURE 1–4 HAND GRIPS

LATERAL CASSETTE HOLDER

The lateral cassette holder is used for cross-table radiography as shown in **Figure 1–5**. The lateral cassette holder is inserted into the tabletop accessory rails.

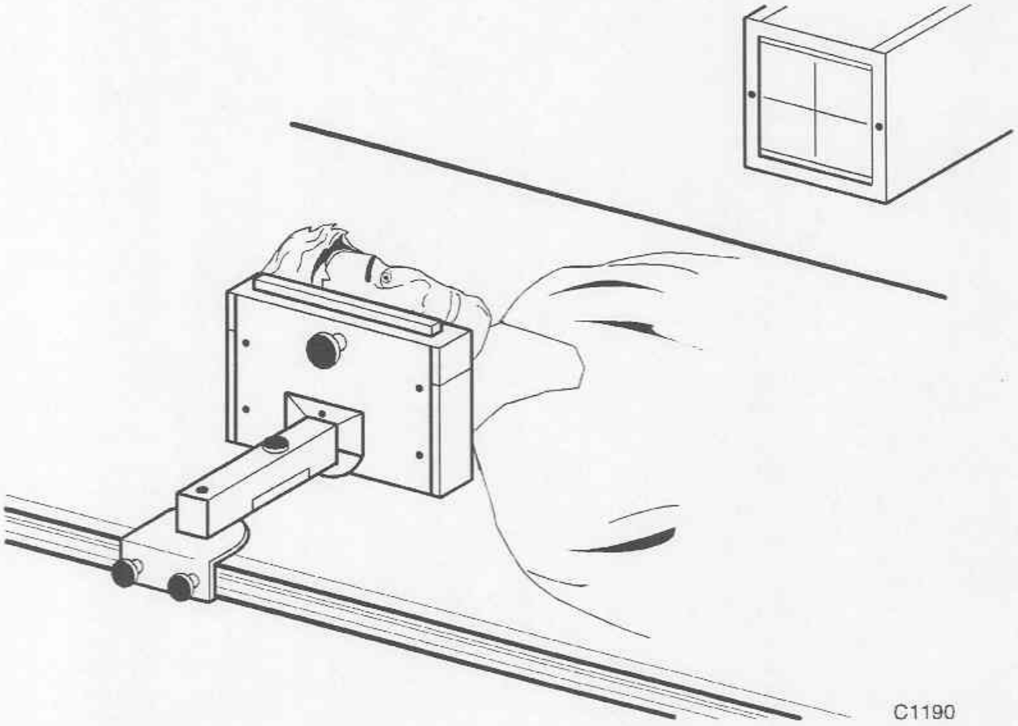


FIGURE 1–5 LATERAL CASSETTE HOLDER

OPERATING LIMITS

TABLE

Tabletop Travel from Center Position

Transverse travel:	± 127 mm
Longitudinal travel:	± 470 mm

BUCKY UNIT

Travel:	560 mm
Tabletop-film distance:	71 mm

Film center to table end distance

Head end:	300 mm (minimum)
Foot end:	400 mm (minimum)

TUBE COLUMN

Focal spot vertical travel:	253 – 1775mm (horizontal beam)
X-ray tube swivel:	+30° and -20° (within trunnions)
Vertical range, support arm:	164 cm
Longitudinal travel, tube column:	128 cm

Rotation of x-ray tube unit about vertical

Column axis:	± 90°
Detents at:	± 90°

Rotation of x-ray tube unit about horizontal

Support arm axis:	± 90°
Detents at:	± 90°

ENVIRONMENTAL

Operating

Temperature:	0° to +37° C (32° to 99° F)
Humidity:	0 to 95%, relative

Storage

Temperature:	-20° to +70° C (-4° to 158° F)
Humidity:	0 to 95%, relative

PREPARATION FOR USE

INTRODUCTION

This procedure is to be used to put the Clinix VP4 into the operational mode after it has been installed or to return it to operation after it has been placed in the transport mode.

SETUP

1. Place the foam pad on the table top as shown in **Figure 2–1**.

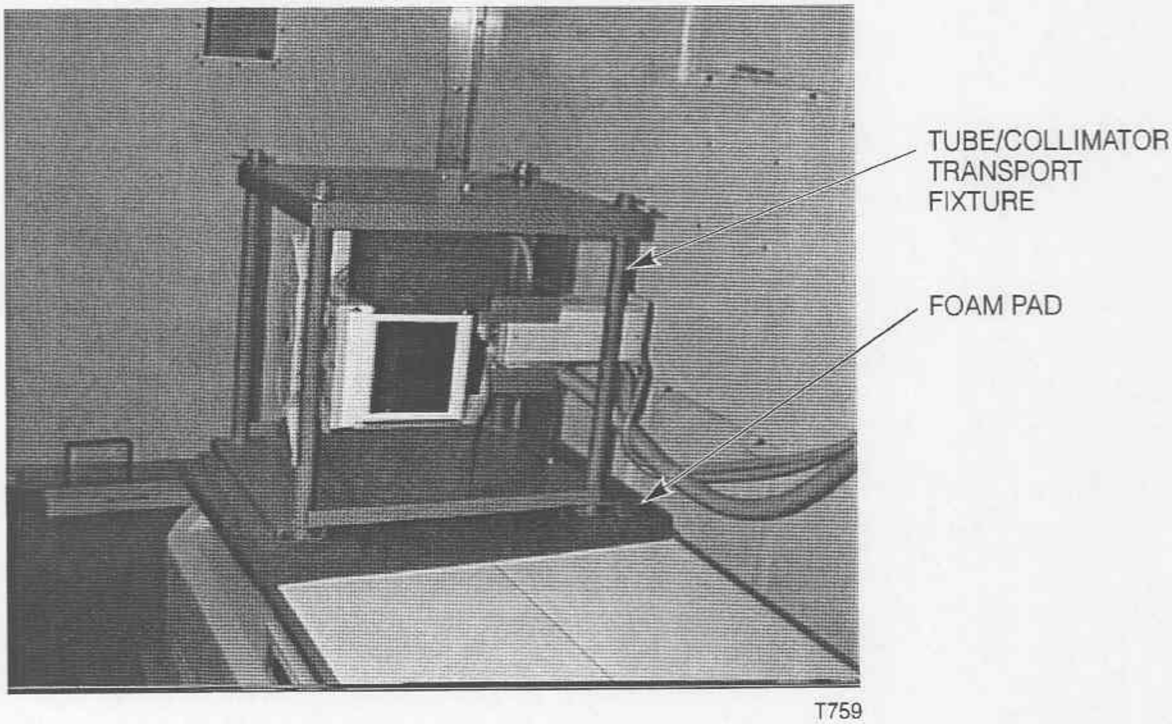


FIGURE 2–1 TUBE/COLLIMATOR ASSEMBLY POSITIONING

2. Employing two people, lift the tube/collimator transport fixture onto the head end of the tabletop as shown **Figure 2–1**.

3. Use the hex key inserted into the belt turnbuckle to loosen and remove the webbed belt holding the vertical column to the column support (see **Figure 2–2**).

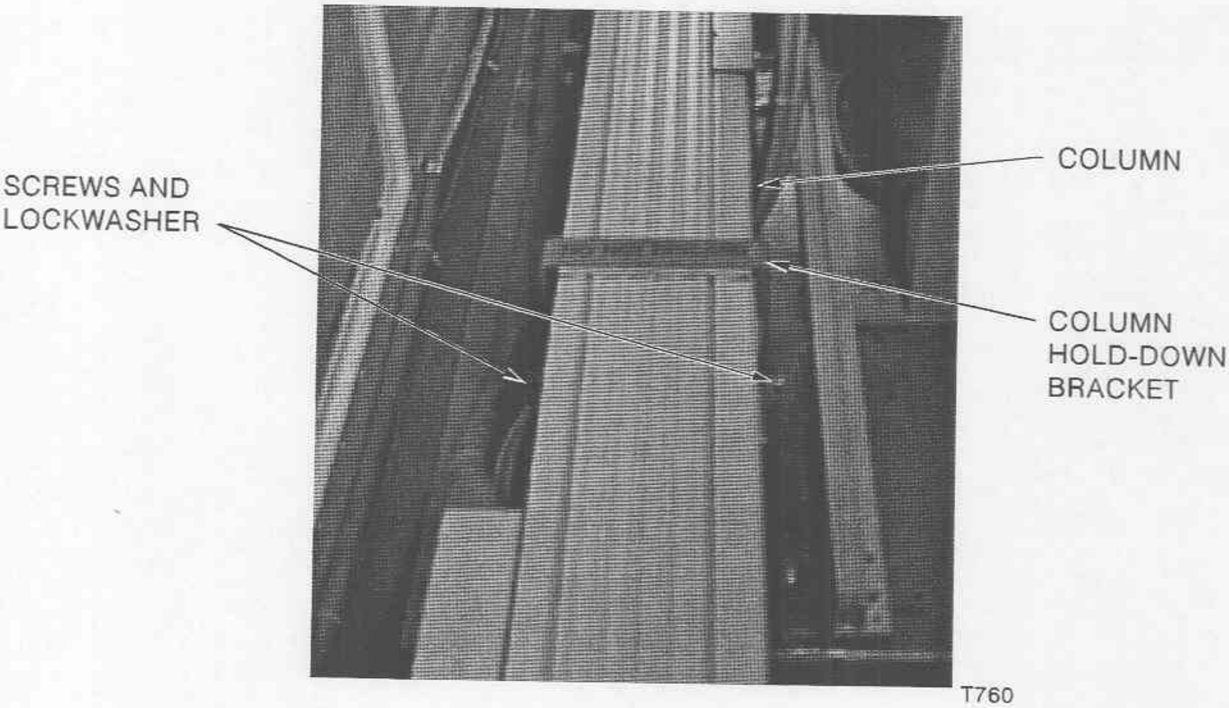
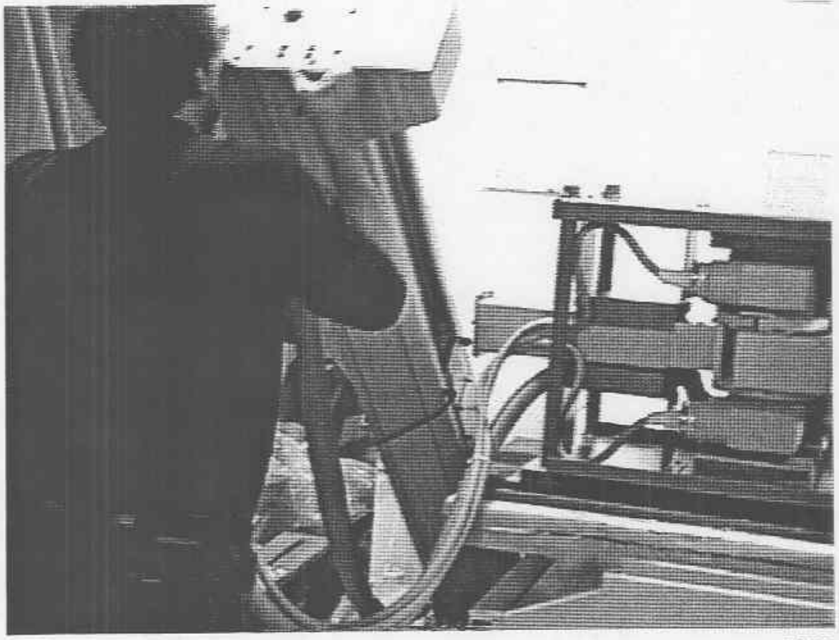

SCREWS AND LOCKWASHER
COLUMN
COLUMN HOLD-DOWN BRACKET
T760

FIGURE 2–2 VERTICAL COLUMN SECURING BELT

4. Slide the vertical column toward the head end as far as it will go. The column hinge should be at the bottom of the column.

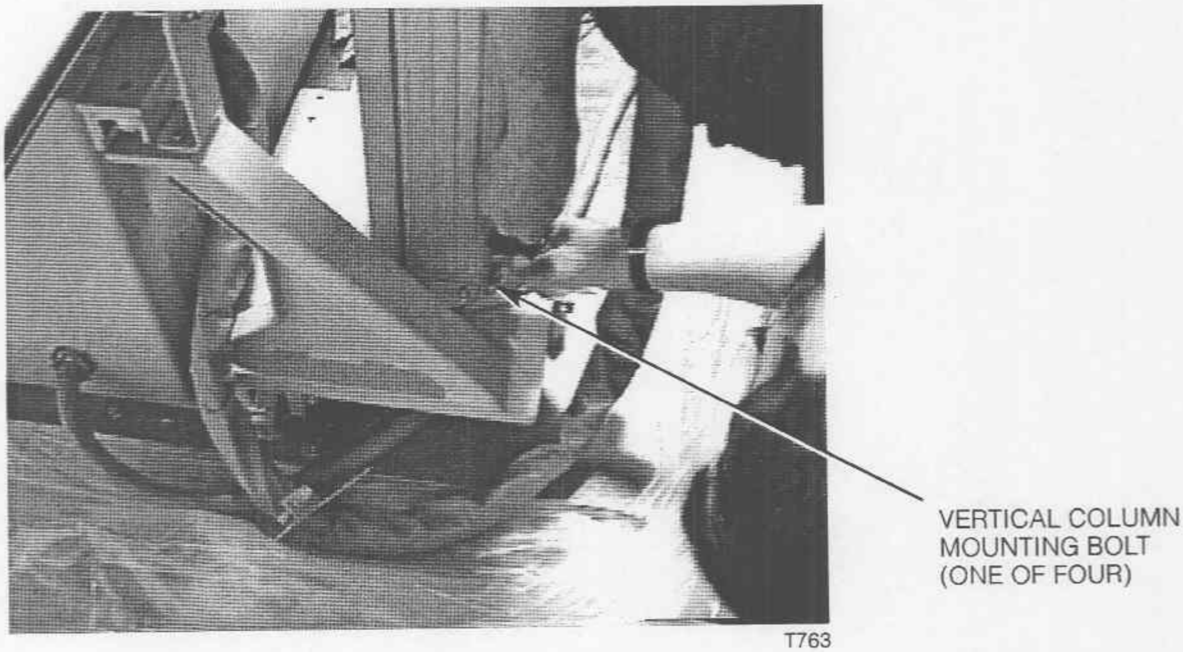
5. Raise the tube column to the vertical position as shown in **Figure 2–3**. The tube column is hinged at the column base.



T762

FIGURE 2–3 RIGHTING THE VERTICAL COLUMN

6. Install the four bolts to secure the base of the column to the longitudinal carriage as shown in **Figure 2–4**.



VERTICAL COLUMN MOUNTING BOLT (ONE OF FOUR)
T763

FIGURE 2–4 VERTICAL COLUMN MOUNTING

7. Remove the four screws that fasten the column hinge to the longitudinal carriage (see **Figure 2–5**).

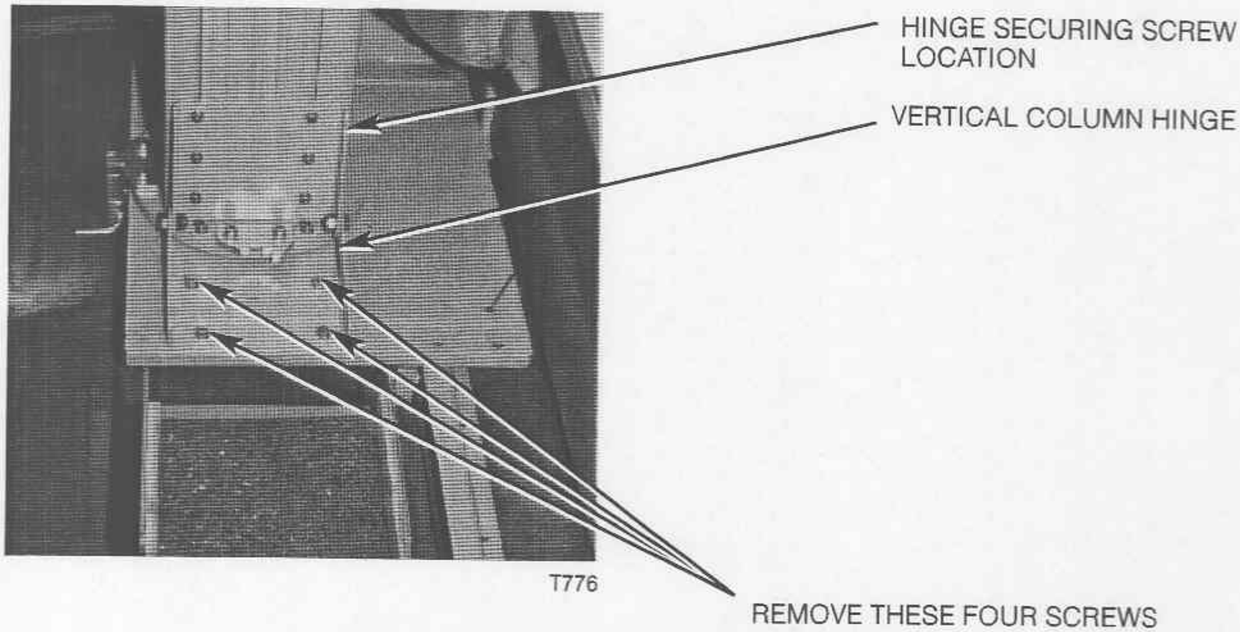

HINGE SECURING SCREW LOCATION
VERTICAL COLUMN HINGE
T776
REMOVE THESE FOUR SCREWS

FIGURE 2–5 COLUMN HINGE

8. Remove the small hinge securing screw indicated in **Figure 2–5**, fold the hinge and secure it with the small screw.

9. Remove the 8 screws that attach the two column transport supports (shown in **Figure 2–6**) to the baseplate and remove the two column supports.

10. Remove the tubearm mounting bolts from the vertical carriage.

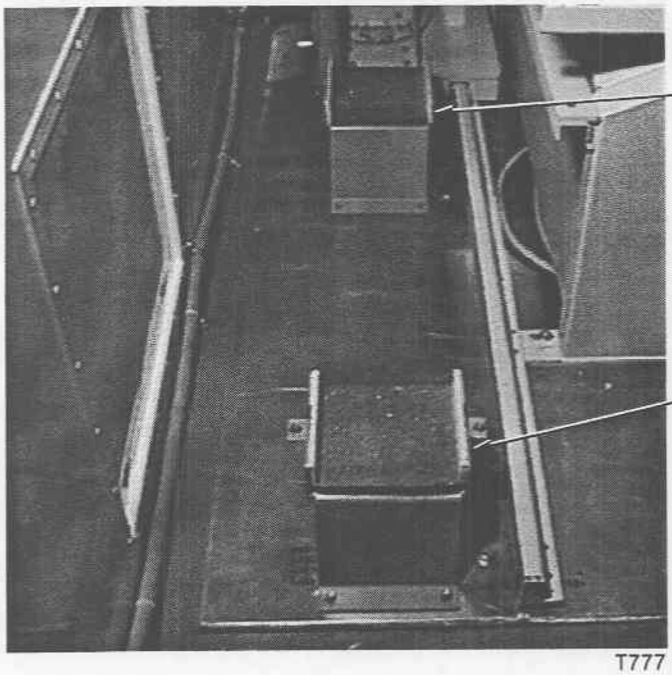

COLUMN SUPPORT BRACKET
COLUMN HOLD-DOWN SUPPORT BRACKET
T777

FIGURE 2–6 COLUMN TRANSPORT SUPPORTS

11. Move the column longitudinally toward the head end so that the transverse tube arm aligns with the vertical carriage as shown in **Figure 2–7**.

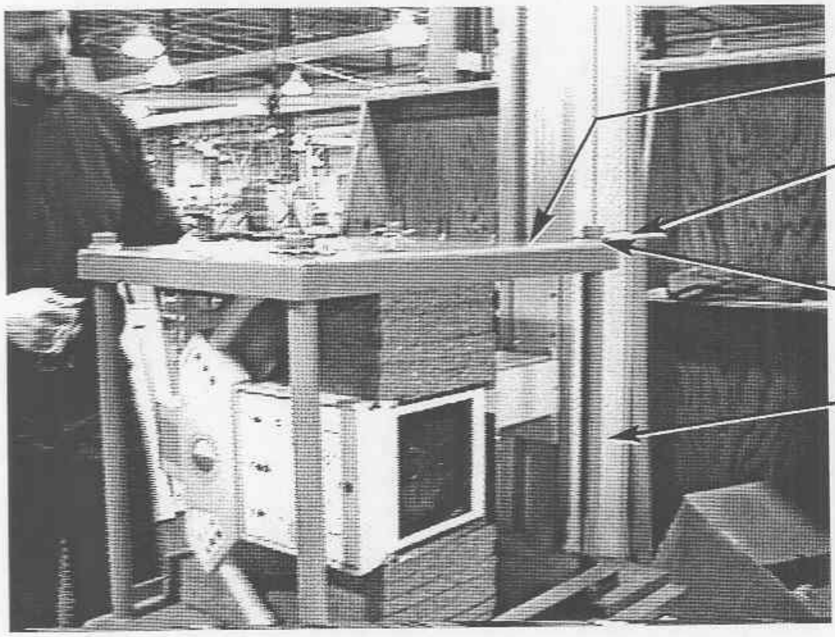

COVER
TOP CLIPS
SPACER
TUBE/ COLLIMATOR TRANSPORT FIXTURE
T770

FIGURE 2–7 TUBEARM AND COLUMN POSITIONING

12. Press the top release foot beam on the front of the table to move the top to the rear to mate the tube arm to the vertical column.

13. Attach the transverse tube arm to the vertical carriage with four bolts as shown in **Figure 2–8**.

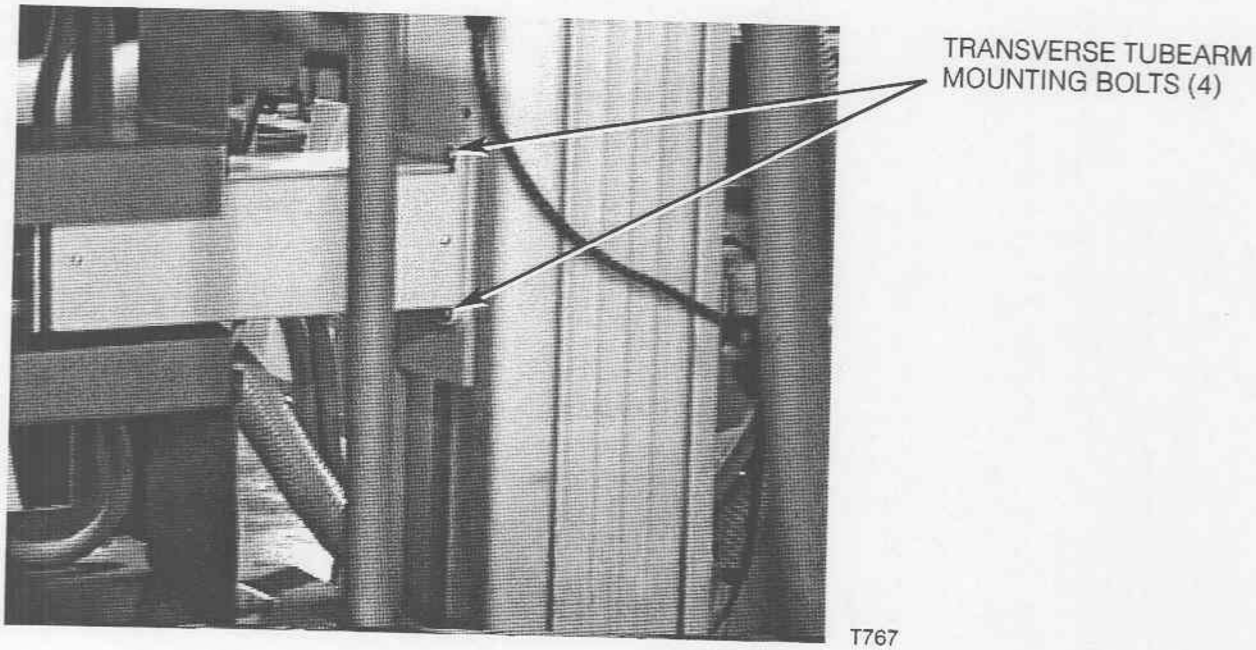


FIGURE 2–8 TRANSVERSE TUBEARM MOUNTING

14. Remove the elastic cord from the vertical carriage.

15. Remove the counterweight support pin from the back of the tube column (see **Figure 2–9**).

16. Turn the pin around and reinstall it in the holding bracket.

17. Remove the clips that hold the top on the tube/collimator transport fixture and remove the top of the fixture (see **Figure 2–8**).

18. Lift the tubehead assembly vertically out of the tube/collimator transport fixture (this may take considerable lifting force unless power is applied to release the vertical locks).

19. Place the top back on the tube/collimator transport fixture and store it for the next time the shelter is to be transported.

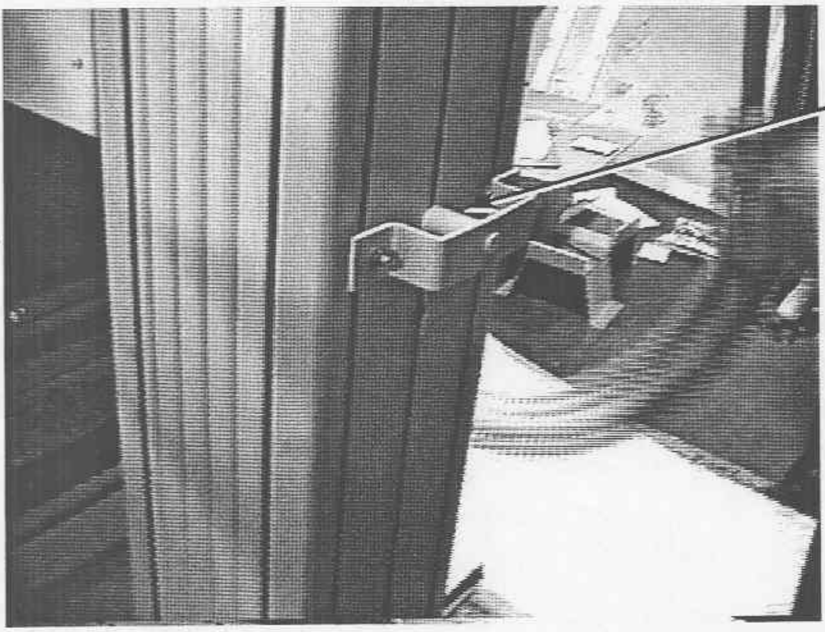

COUNTERWEIGHT
SUPPORT PIN
(INSERTED POSITION)
T768

FIGURE 2–9 COUNTERWEIGHT SUPPORT PIN

20. Push the excess cable into the hole in the back of the table (see **Figure 2–10)** and mount the hole cover as shown.

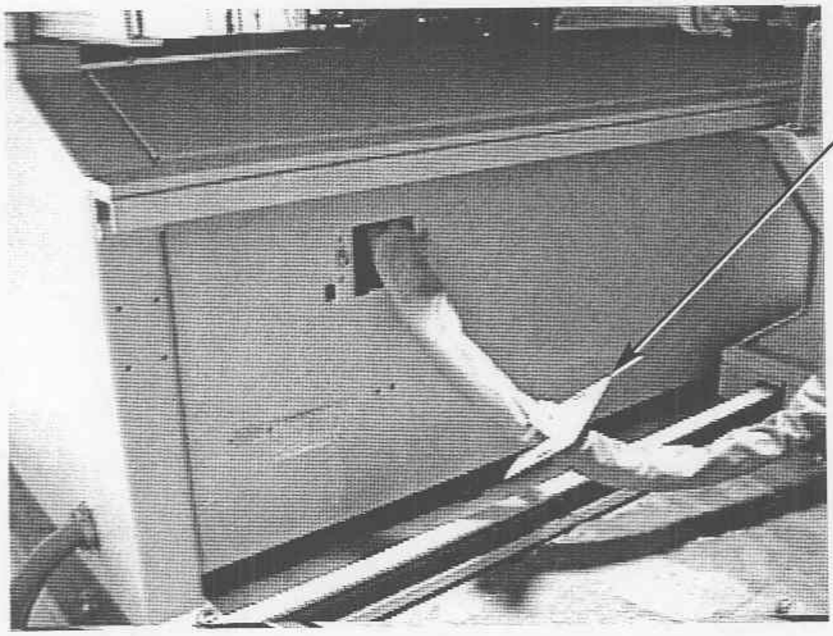

HOLE COVER
T771

FIGURE 2–10 INSTALLING HOLE COVER

CHECKOUT

If any of the checkout procedures contained in this paragraph fail, do not continue with the checkout procedures or use the x-ray system until the malfunction is remedied.

1. Apply power to the system by pressing the power on (I) switch on the control panel. Verify that power is applied (indicators illuminated) and that no error codes are displayed in the ms display area.

2. Checkout tubestand motion/locks as follows:

    a. While holding the handles of the control arm, press and hold the longitudinal brake release switch (↔).

    b. Using the control arm handles, verify free movement of the tubestand in both longitudinal directions.

    c. Release the longitudinal brake release switch and verify no tubestand movement in either longitudinal direction.

    d. While holding the handles of the control arm, press and hold the vertical brake release switch (↕).

    e. Using the control arm handles, verify free movement of the control arm in both vertical directions.

    f. Release the vertical brake release switch and verify no control arm movement in either vertical direction.

    g. While holding the handles of the control arm, press and hold the transverse brake release switch (⤢).

    h. Using the control arm handles, verify free transverse movement of the control arm in both transverse directions.

    i. Release the transverse brake release switch and verify no transverse movement of the control arm.

    j. While holding the handles of the control arm, press and hold the angular brake release switch (✳).

    k. Using the control arm handles, verify free angular (rotational) movement of the control arm in both directions.

    l. Release the angular brake release switch and verify no angular control arm movement in either direction.

3. Checkout table top motion/locks as follows:
    a. Step on and hold the brake release pedal to release the table top.
    b. Verify smooth movement in both the longitudinal and transverse directions of the table top.
    c. Release the brake release pedal.
    d. Verify that the table top has no movement in both the longitudinal and transverse directions.
4. Checkout collimator functions as follows:
    a. On the collimator, press the **Collimator Light** switch (▣).
    b. Verify that the collimator light illuminates.
    c. Place a cassette in the bucky tray. Refer to **Inserting a Cassette** in the **OPERATION** section of this manual.
    d. Using the control arm and control arm controls, ensure that the angular rotation of the control arm is at 0° (zero degrees).
    e. Position the control arm to a 36 inch minimum SID.
    f. Verify that the **Automatic Collimation** indicator (⌓) illuminates (green).
    g. Press and hold the **Angular Motion Brake** switch (⌒) and rotate the control arm to an angle greater than 3° in both directions.
    h. Verify that the **Collimation Manual Mode** indicator (◭) illuminates (yellow).
    i. Press and hold the **Vertical Brake Release** switch (↕) and move the control arm to an SID below 36 inches.
    j. Verify that the **Collimation Manual Mode** indicator (◭) illuminates (yellow).
    k. Position the control arm back to an SID greater then 36 inches.
    l. Press the **Manual Collimation** selector switch (◭).

m. Verify that the **Collimation Manual Mode** indicator (◭) illuminates (yellow).

n. Press the **Manual Collimation** selector switch (◭) again to enable automatic mode.

5. Checkout exposure as follows:

a. Using the control panel controls, ensure that **AEC** (○⊞) is not selected (indicator extinguished).

b. Note the value in the mAs display and make an exposure.

c. After the exposure read the actual mAs reading. This value must be the same as the pre-exposure value.

d. Press the **AEC** switch (○⊞) to enable **AEC** (indicator illuminated), or select an **APR** that includes **AEC** (indicator illuminated).

e. Make an exposure.

f. Verify that the **BUT** indicator is not illuminated.

6. The system is now ready for use.

CONTROLS AND INDICATORS

INTRODUCTION

This section provides the controls and indicators information required for operation of the Clinix VP4 X-Ray System. All x-ray functions are available on the Generator Control Panel. The generator control panel is mounted on a pedestal. It contains visual displays and groups of controls for standard functions which include power ON/OFF, exposure control, technique selection and APR (Anatomically Programmed Radiography) and AEC (Automatic Exposure Control) functions.

The Clinix VP4 x-ray system also contains other mechanical controls available at various positions on the x-ray table. All controls and indicators are described in the paragraphs that follow.

GENERATOR CONTROL PANEL

A view of the Operator Console control panel is provided in **Figure 3–1**.

For the purposes of this section, the control panel is divided into five functional groups, as shown in **Figure 3–1**.

The five functional groups are defined as follows:

1. Power Controls
2. Exposure Controls and Indicators
3. Technique Select Controls and Indicators
4. Automatic Exposure Control (AEC) Controls and Indicators
5. Anatomically Programmed Radiography (APR) Controls and Indicators

Each of the five functional groups is explained in detail in the following paragraphs. Each control has an associated indicator that illuminates when that control is active/selected.

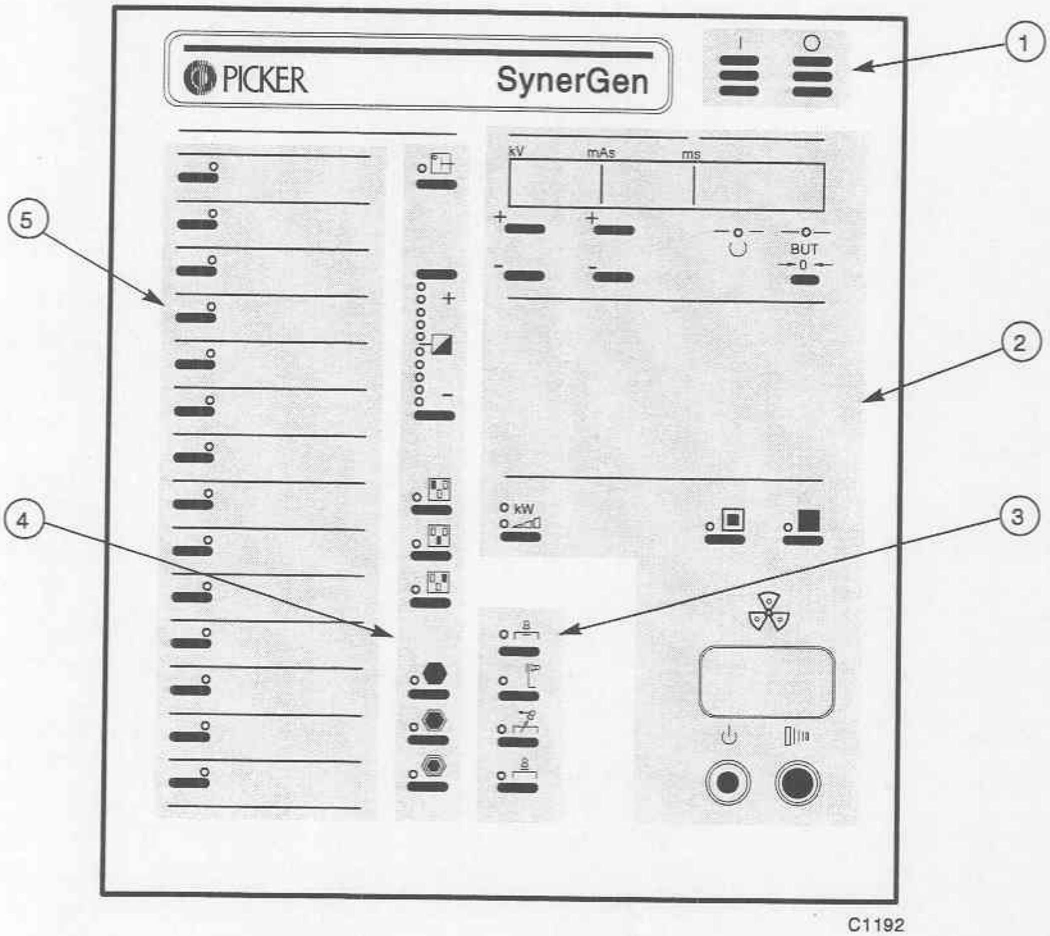

PICKER
SynerGen
kV
mAs
ms
BUT
0
kW
1
2
3
4
5
C1192

FIGURE 3–1 GENERATOR CONTROL PANEL

POWER CONTROLS

The controls and indicators associated with the Power Controls functional group is shown in **Figure 3–2**. Each control and/or indicator is described or defined in **Table 3–1**.

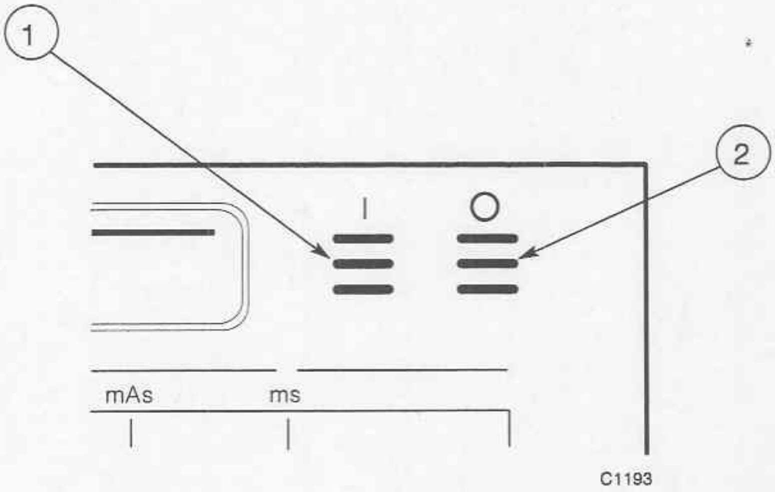


FIGURE 3–2 CONTROL PANEL POWER CONTROLS

TABLE 3–1 CONTROL PANEL POWER CONTROLS

No.	Control/Indicator	Function
1	I Switch (Power On)	Power is applied to the generator system when this switch is pressed.
2	O Switch (Power Off)	Power is removed from the generator system when this switch is pressed.

EXPOSURE CONTROLS AND INDICATORS

The controls and indicators associated with the Exposure Controls functional group is shown in **Figure 3–3**. Each control and/or indicator is described or defined in **Table 3–2**.

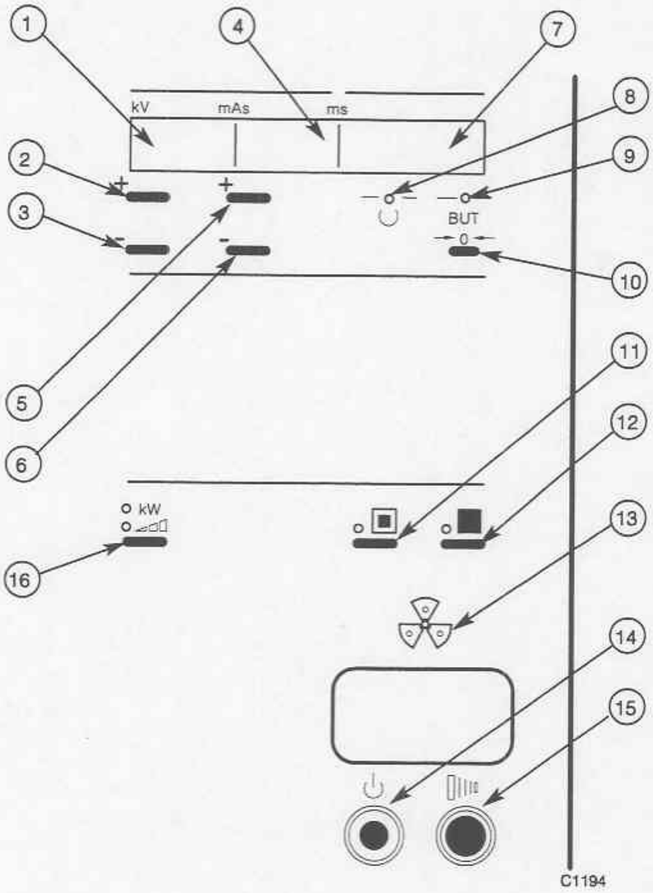


FIGURE 3–3 EXPOSURE CONTROLS AND INDICATORS

After exposure, displays actual mAs value for approximately 40 seconds, then displays previous value.

Displays message information when appropriate. Indicates that an exposure is being made.

TABLE 3–2 EXPOSURE CONTROLS AND INDICATORS

No.	Control/Indicator	Function
1	kV Display	X-ray tube voltage indication. Displays programmed or manually selected kV value.
2	+ Control (kV)	Increases the kV setting in 1 kV increments.
3	− Control (kV)	Decreases the kV setting in 1 kV increments.
4	mAs Display	1. Prior to exposure, displays programmed or manually selected mAs value. 2. After exposure, displays actual mAs value for approximately 40 seconds, then displays previous value.
5	+ Control (mAs)	Increases the mAs setting in a total of 32 increments.
6	− Control (mAs)	Decreases the mAs setting in a total of 32 increments.
7	ms Display	1. Displays backup time or exposure time in milliseconds. 2. Displays error messages when appropriate.
8	⍜ Indicator	Illuminates when system is ready for use. Extinguishes when PREP switch is pressed. Illuminates again when system is ready to make exposures.
9	BUT Indicator	Illuminates when the mAs limit is reached during an exposure with AEC (Automatic Exposure Control).
10	BUT Switch	Resets a Back-Up Time indication.
11	▣ Switch	Selects a small focal spot.
12	■ Switch	Selects a large focal spot.
13	☢ Indicator	Illuminates whenever radiation is present.
14	⏻ Switch	Begins rotation of the anode and prepares the generator for exposures.
15	⦀ Switch	Initiates the exposure with all current settings. If pressed without pressing prep switch first, x-ray tube preparation is performed first automatically.
16	kW Switch	Toggles between one of three pre-programmed long exposures times.

TECHNIQUE SELECT CONTROLS AND INDICATORS

The controls and indicators associated with the technique Select Controls functional group is shown in **Figure 3–4**. Each control and/or indicator is described or defined in **Table 3–3**.

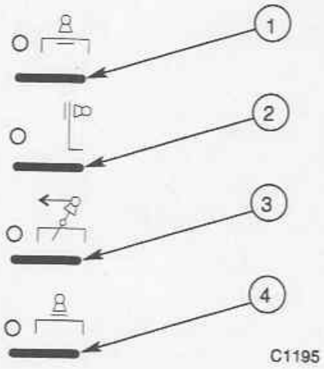


FIGURE 2–4 TECHNIQUE SELECT CONTROLS AND INDICATORS

TABLE 2–3 TECHNIQUE SELECT CONTROLS AND INDICATORS

No.	Control/Indicator	Function
1	Control	Selects over-head x-ray tube and an under-table bucky tray.
2	Control	Selects wall bucky technique. Not used with Clinix VP4.
3	Control	Selects Tomo technique. Not used with Clinix VP4.
4	Control	Selects table top technique. Used for placeing film directly on table top or for lateral cassette holder use.

AUTOMATIC EXPOSURE (AEC) CONTROLS AND INDICATORS

The controls and indicators associated with the Automatic Exposure Controls functional group is shown in **Figure 3–5**. Each control and/or indicator is described or defined in **Table 3–4**.

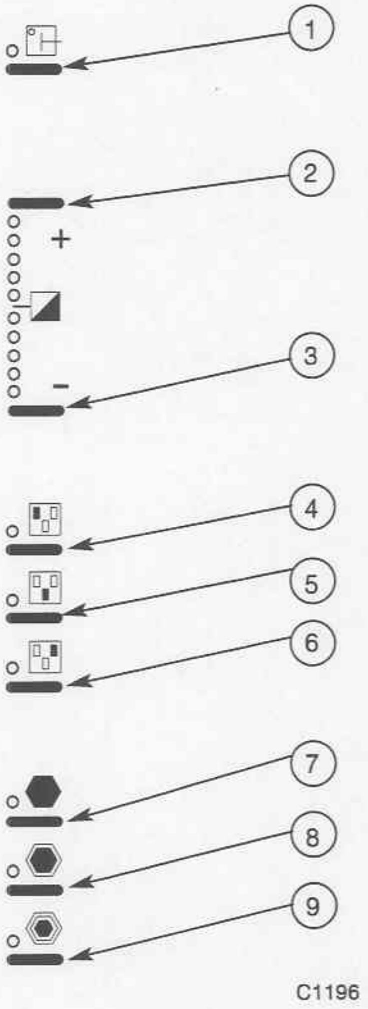


FIGURE 3–5 AEC CONTROLS AND INDICATORS

TABLE 3–4 AEC CONTROLS AND INDICATORS

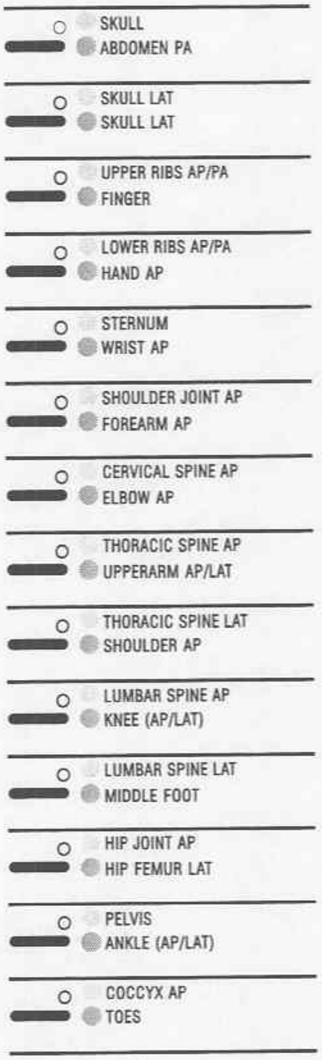
No.	Control/Indicator	Function
1	Switch	Enables AEC (indicator illuminated). When an APR selection is made that includes AEC, AEC is automatically enabled (indicator illuminated).
2	+ Switch	Increases the density as indicated by the graduated LED display, in pre-programmed density percentages.
3	– Switch	Decreases the density as indicated by the graduated LED display, in pre-programmed density percentages.
4	Switch	Enables the left field for exposure. Indicator illuminates when selected.
5	Switch	Enables the center field for exposure. Indicator illuminates when selected.
6	Switch	Enables the right field for exposure. Indicator illuminates when selected.
7	Switch	Selects one of three pre-programmed screen speeds (fastest). Indicator illuminates when selected.
8	Switch	Selects one of three pre-programmed screen speeds. Indicator illuminates when selected.
9	Switch	Selects one of three pre-programmed screen speeds (slowest). Indicator illuminates when selected.

APR CONTROLS AND INDICATORS

The controls and indicators associated with the Anatomically Programmed Radiography (APR) Controls functional group is shown in **Figure 3–6**.

Fouteen (14) different APR procedures are provided for each available technique selection. This provides 28 different pre-programmed procedures.

The indicator adjacent to the selected APR illuminates when that APR procedure is selected.


SKULL
ABDOMEN PA
SKULL LAT
SKULL LAT
UPPER RIBS AP/PA
FINGER
LOWER RIBS AP/PA
HAND AP
STERNUM
WRIST AP
SHOULDER JOINT AP
FOREARM AP
CERVICAL SPINE AP
ELBOW AP
THORACIC SPINE AP
UPPERARM AP/LAT
THORACIC SPINE LAT
SHOULDER AP
LUMBAR SPINE AP
KNEE (AP/LAT)
LUMBAR SPINE LAT
MIDDLE FOOT
HIP JOINT AP
HIP FEMUR LAT
PELVIS
ANKLE (AP/LAT)
COCCYX AP
TOES

C1197

FIGURE 3–6 APR CONTROLS AND INDICATORS

NOTE

The APR procedures may be selectively changed to meet user preferences. Refer to **Changing Anatomically Programmed Radiography (APR) Selections** in the **OPERATION** section of this manual.

TABLE

BRAKE RELEASE PEDAL BAR

The tabletop (item 1, **Figure 3–7**) may be positioned manually by stepping on the foot-operated brake release pedal bar (item 2, **Figure 3–7**) to release the tabletop brakes and position the floating tabletop manually.

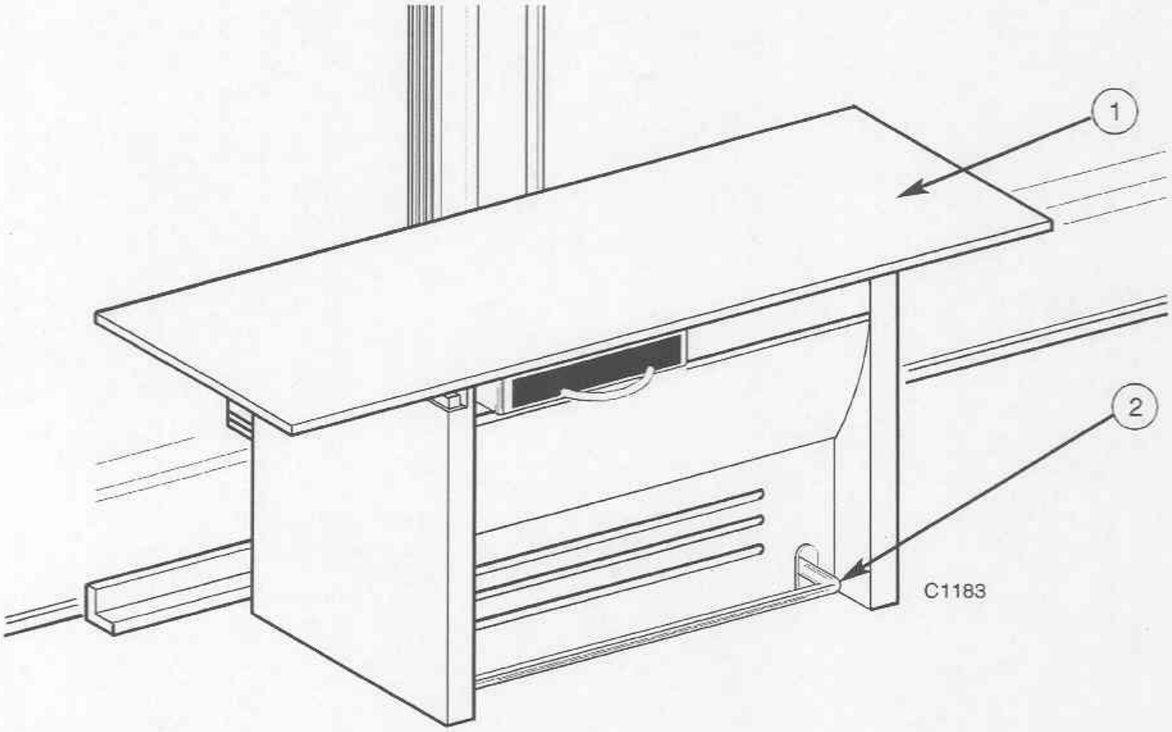


FIGURE 3–7 BUCKY TABLE RELEASE BAR

The tabletop travel from the center position is as follows:

1. Transverse travel is ± 127 mm
2. Longitudinal travel is ± 470 mm

CAUTION

BRING THE TABLETOP INTO THE FORWARD POSITION BEFORE LOADING OR UNLOADING THE PATIENT.

BUCKY UNIT

The bucky unit consists of a cassette tray and is shown in **Figure 3–8**. The cassette tray positions the cassette in the bucky unit. Maximum bucky unit travel is 560 mm.

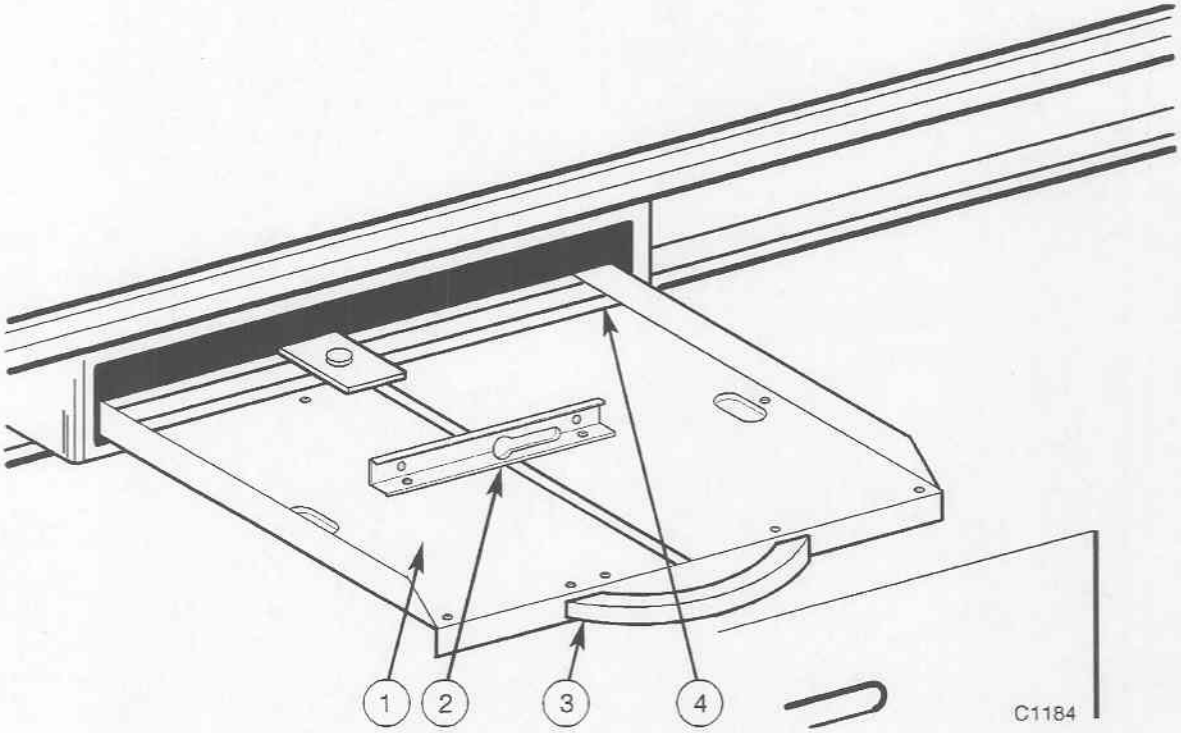


FIGURE 3–8 BUCKY UNIT CONTROLS

An explanation of each bucky unit control is provided in **Table 3–5**.

TABLE 2–5 BUCKY UNIT CONTROLS

No.	Control/Indicator	Function
1	Cassette Tray	Holds the film cassette in place during exposures.
2	Cassette Clamp	Locks the film cassette in position in the cassette tray.
3	Handle	Allows for easy access to the cassette tray.
4	Cassette Positioner	Used to align the cassette to the center of the cassette tray.

SAFETY COUPLING

The safety coupling connects the bucky unit with the tubestand. When engaged, the safety coupling maintains the alignment of the x-ray tube unit with the bucky, when the x-ray tube is moved longitudinally. If the tubestand is moved beyond the travel range of the bucky, the safety coupling disengages the bucky from the tubestand automatically. If the tubestand is moved back into the travel range of the bucky, the safety coupling automatically re-engages the tubestand to the bucky.

CAUTION

ENSURE THAT THE SAFETY COUPLING IS PROPERLY ENGAGED, OR THE CENTRAL RAY WILL NOT COINCIDE WITH THE CENTER OF THE FILM.

ROTATION OF THE TUBESTAND (±90°) SHOULD BE PERFORMED WITH THE TUBESTAND LOCATED AT THE HEAD END, BECAUSE THE SAFETY COUPLING IS DISENGAGED IN THAT LOCATION. THIS PRECAUTION ENSURES A POSITIVE ENGAGEMENT OF THE COLUMN IN THE DETENT.

TUBESTAND

The tubestand controls and indicators are shown in **Figure 3–9**.

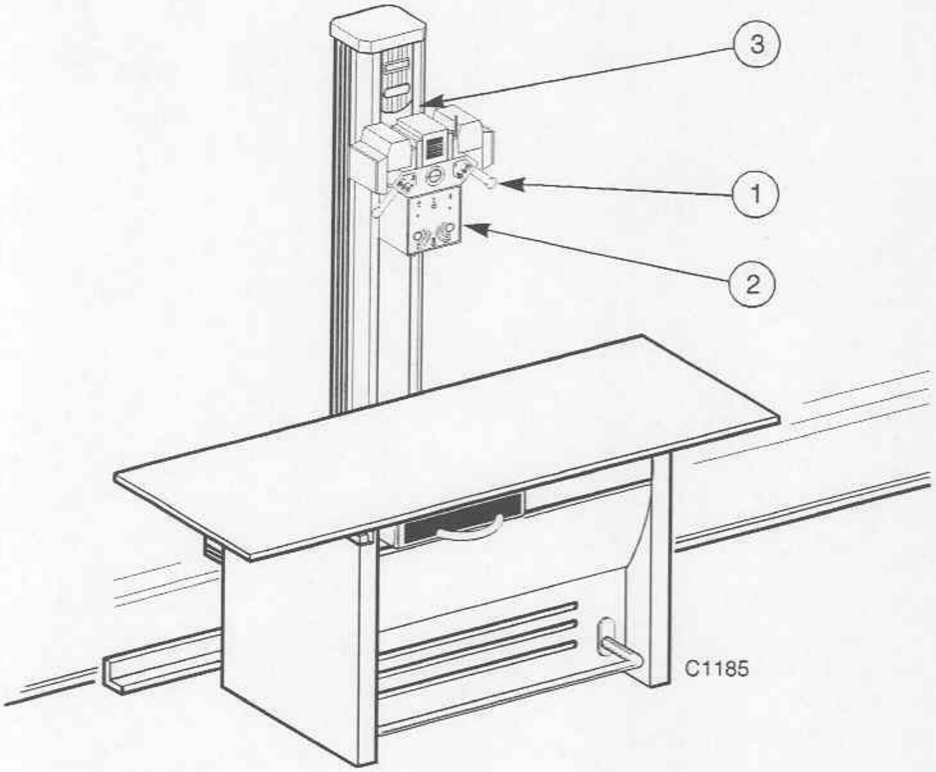


FIGURE 3–9 TUBESTAND CONTROLS AND INDICATORS

The controls and indicators of the tubestand are described in **Table 3–6**.

TABLE 3–6 TUBESTAND CONTROLS AND INDICATORS

No.	Control/Indicator	Function
1	Control Arm	Refer to control arm paragraph.
2	Collimator	Refer to collimator paragraph.
3	SID Indicator	A scale on the tubestand indicating the SID.

CONTROL ARM

The control arm allows for controlled movement of the x-ray tube including angular motion. The control arm is shown in **Figure 3–10**.

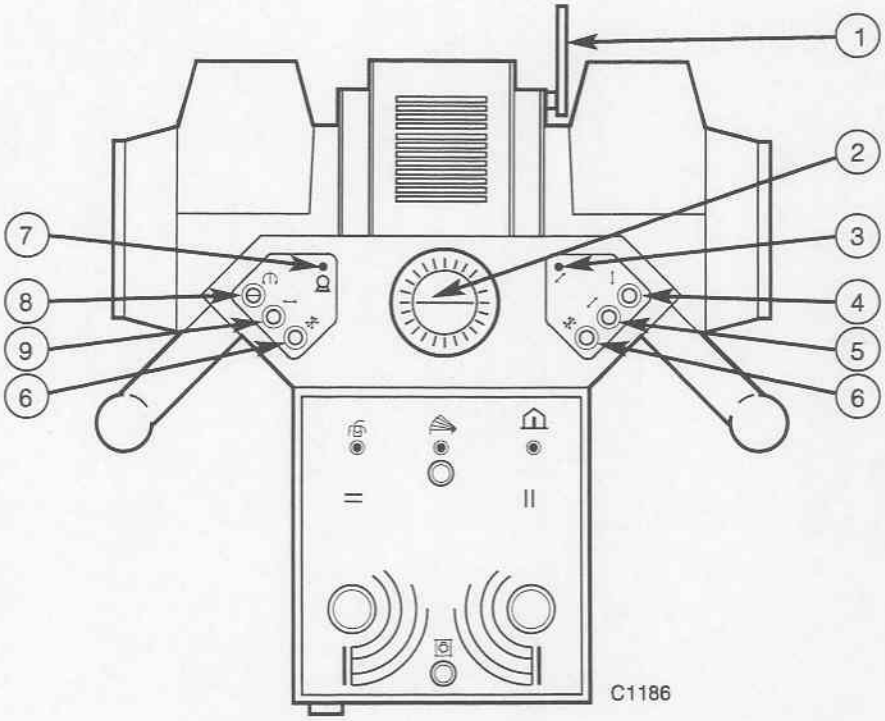


FIGURE 3–10 CONTROL ARM CONTROLS AND INDICATORS

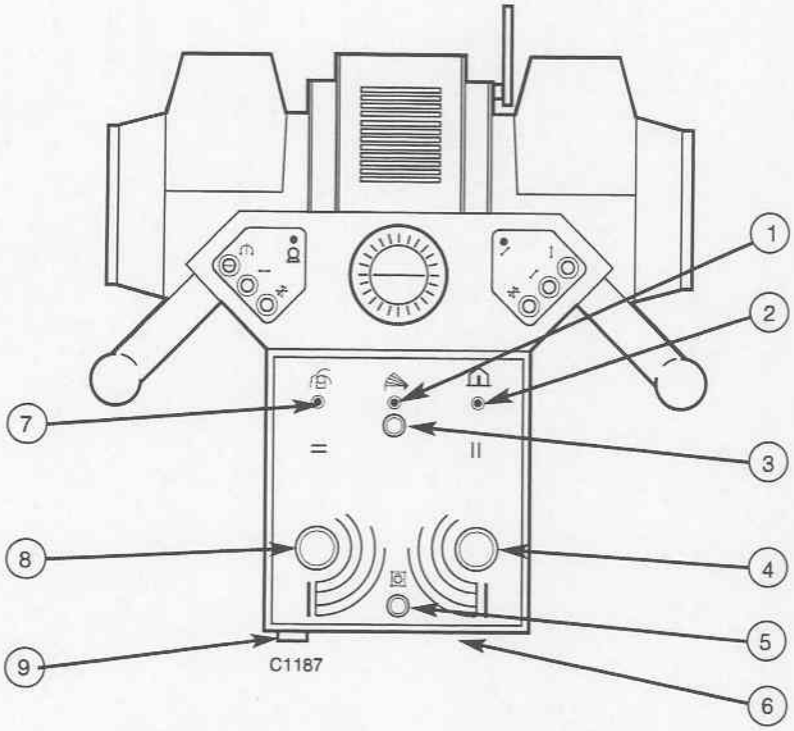
The controls are operated from the front (operator side) of the tubestand. With the handles grasped, pressure by the operator's thumb on the control arm buttons can easily release the electromagnetic brakes related to one or more of the movements to allow convenient and accurate positioning of the x-ray tube unit. A description of each control and/or indicator is provided in **Table 3–7**.

TABLE 3–7 CONTROL ARM CONTROLS AND INDICATORS

No.	Control/Indicator	Function
1	Lock Handle	Locks x-ray tube in swivel position.
2	Angle Indicator	Indicates angle of x-ray tube unit (rotation about horizontal support arm axis).
3	Center Indicator	Illuminates when x-ray tube is centered transversely to tabletop centerline.
4	Vertical Brake Release	Releases brake for vertical travel of x-ray tube unit.
5	Traverse Brake Release	Releases brake for transverse travel of x-ray tube unit.
6	Central Brake Control	When actuated, all movements are available, except angular motion of the x-ray tube unit.
7	Bucky Select Indicator	Illuminates when bucky table is selected at x-ray generator control.
8	Angular Motion Brake	Releases brake for angular motion of x-ray tube unit (rotation about the horizontal support arm axis).
9	Longitudinal Brake Release	Releases brake for longitudinal travel of the tubestand.

COLLIMATOR

The collimator controls and indicators are shown in **Figure 3–11** and the corresponding functions are tabulated in **Table 3–8**.


1
2
3
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5
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7
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9
C1187

FIGURE 3–11 COLLIMATOR CONTROLS AND INDICATORS

TABLE 3–8 COLLIMATOR CONTROLS AND INDICATORS

No.	Control/Indicator	Function
1	Collimation Manual Mode Indicator	Illuminates when manual collimation mode is selected.
2	SID Range Indicator	Illuminates when exposure is inhibited due to a collimation error.
3	Manual Collimation Selector	Selects/Deselects manual collimation mode.
4	Collimator Adjustment Control	Allows for manual opening and closing of collimator vanes (longitudinally to tabletop).
5	Collimator Light Switch	Turns on collimator light.
6	Center Indicator	Illuminates (for approximately 30 seconds) when collimator light switch is pressed.
7	Automatic Collimation Indicator	Illuminates when conditions for automatic collimation are met (cassette in bucky tray, x-ray tube unit in 36" to maximum SID range, vertical central ray).
8	Collimator Adjustment Control	Allows for manual opening and closing of collimator vanes (transversely to tabletop).
9	Measuring Tape	Convenient method of checking SID.

OPERATION

INTRODUCTION

This section provides the operator with important operating instructions. Prior to operating the system, become familiar with the various components and controls and indicators described in the sections entitled **Equipment Description** and **Controls and Indicators.**

APPLICATION OF POWER

POWER ON

CAUTION

UPON APPLICATION OF POWER, A MINIMUM WARM-UP TIME OF 90 SECONDS IS REQUIRED PRIOR TO MAKING THE FIRST EXPOSURE. IF AN EXPOSURE IS MADE PRIOR TO THE 90 SECOND WARM-UP TIME, DAMAGE TO THE EQUIPMENT MAY RESULT.

1. Power to this generator system is applied by pressing the I (ON) switch located in the upper right hand corner of the control panel.
2. On the collimator, select manual collimation mode (Collimation Manual Mode indicator illuminated).
3. Using the collimator adjustment controls, fully close the collimator vanes.
4. On the control panel, select table top technique (indicator illuminated).
5. Select the **ABDOMEN PA** APR program by pressing the top APR key (indicator illuminated).
6. After the 90 second warm-up time has expired, make two exposures. The tube is now ready for normal operations.

POWER OFF

To remove power, press the **O** (OFF) switch located in the upper right hand corner of the control panel.

OPERATION

POSITIONING PATIENT ON TABLETOP

1. Step on the brake release pedal bar (**Figure 4–1**) and move the tabletop into position for convenient loading of patient.

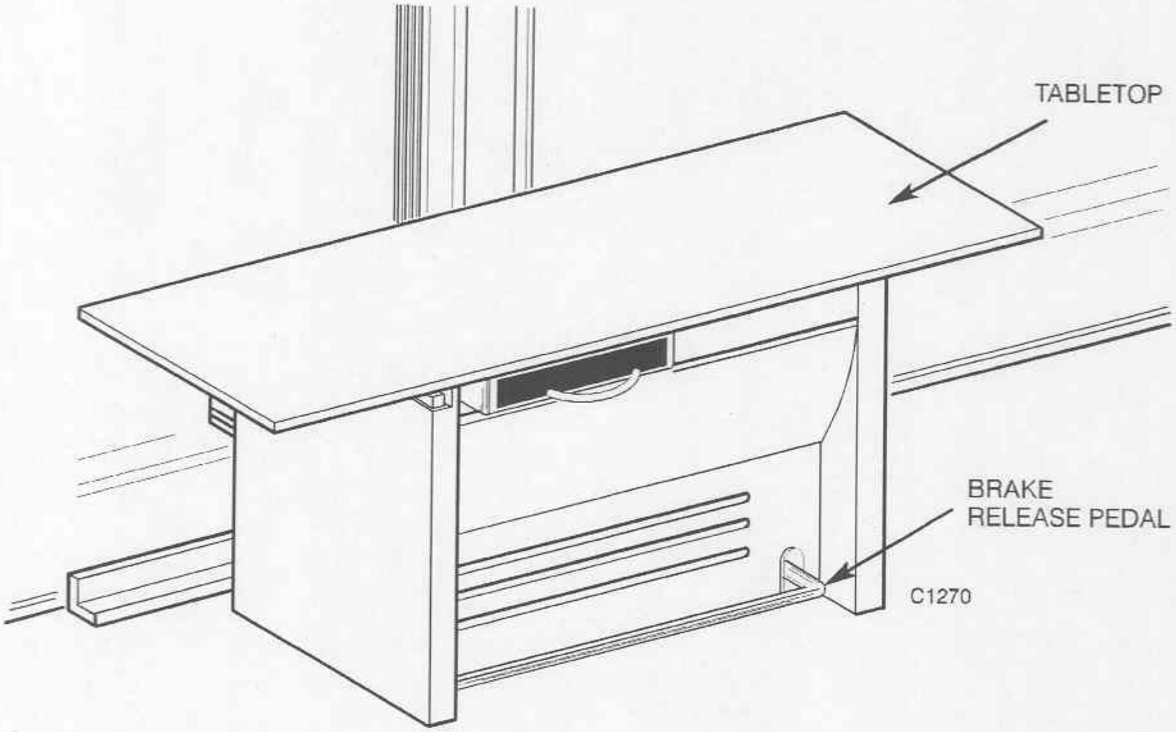


FIGURE 4–1 TABLETOP BRAKE RELEASE

2. Release the brake release pedal bar.

3. Assist the patient in mounting and lying down on the table.

4. Step on the brake release pedal bar and position the patient by moving the floating tabletop.

UNLOADING PATIENT FROM TABLETOP

1. Step on the brake release pedal bar (**Figure 4–1**) and move the tabletop into position for convenient unloading of patient.

2. Release the brake release pedal bar.

3. Assist patient in dismounting from table.

POSITIONING THE X-RAY TUBE

Transverse Centering to Bucky Centerline

1. While holding the handles of the control arm (**Figure 4–2**), press the transverse brake release switch (⤢) to release the brake for transverse travel of the x-ray tube unit.

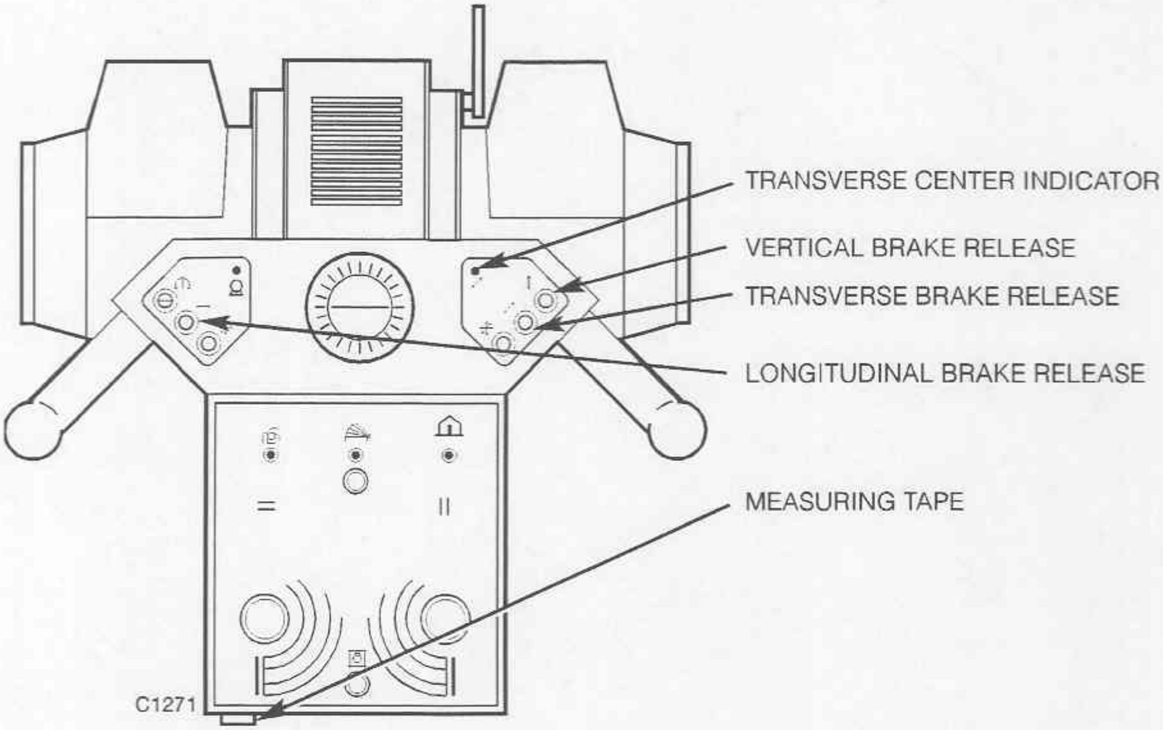

TRANSVERSE CENTER INDICATOR
VERTICAL BRAKE RELEASE
TRANSVERSE BRAKE RELEASE
LONGITUDINAL BRAKE RELEASE
MEASURING TAPE
C1271

FIGURE 4–2 POSITIONING X-RAY TUBE

2. Move the x-ray tube unit across the bucky table until the transverse center indicator illuminates.

Longitudinal Centering to Bucky Centerline

1. While holding the handles of the control arm (**Figure 4–2**), press the longitudinal brake release switch (⟷) to release the brake for the longitudinal travel of the x-ray tube unit.

2. Move the x-ray tube unit longitudinally along the bucky table until the bucky unit is engaged by the safety coupling.

Selecting the Source-To-Image Distance (SID)

1. While holding the two handles of the control arm (**Figure 4–2**), press the vertical brake release switch (↕) to release the brake for the vertical travel of the x-ray tube unit.

2. Use the measuring tape or the SID indicator on the column to adjust the position of the x-ray tube unit to the desired SID.

INSERTING A CASSETTE

A film cassette may be placed into the bucky tray, on top of the table or the lateral cassette holder. The following procedures describe the use of the bucky tray and the lateral cassette holder.

Bucky Tray

1. Pull out the cassette tray by its handle (**Figure 4–3**) from the bucky until it hits the forward stop.

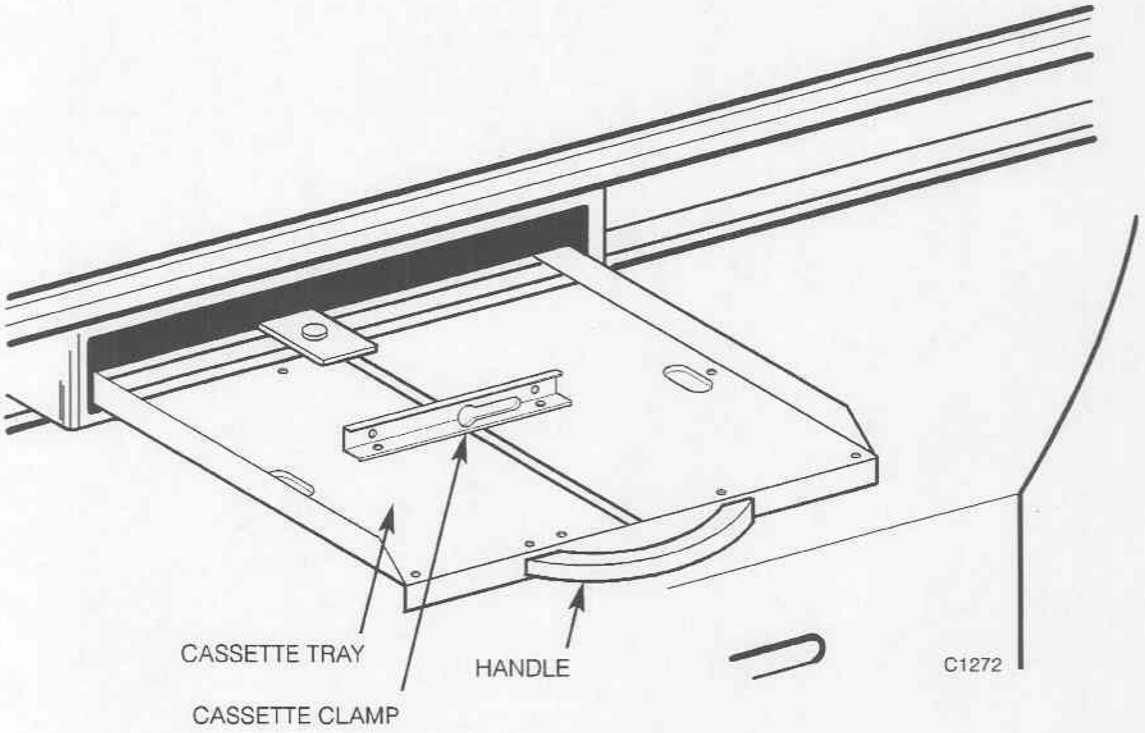


FIGURE 4–3 INSERTING A CASSETTE IN TABLE BUCKY

2. The cassette clamp centers the cassette transversely within the bucky tray. Rotate its latch counterclockwise to unlock it.

3. Open the jaw of the cassette clamp far enough to insert a cassette of the desired size.

4. Insert the cassette, with its transverse centerline aligned with the notches in the jaw of the cassette clamp.

5. Push the jaw of the cassette clamp against the cassette, and rotate the latch into the locked position.

6. Push the cassette tray fully into the bucky.

Lateral Cassette Holder

1. Position lateral cassette holder to tabletop siderails and secure in place.

2. Slide cassette into lateral cassette holder.

ADJUSTING THE FIELD SIZE

1. If the collimator is in the automatic mode, the automatic collimation indicator (**Figure 4–4**) illuminates. The collimator automatically adjusts to the size of the inserted cassette.

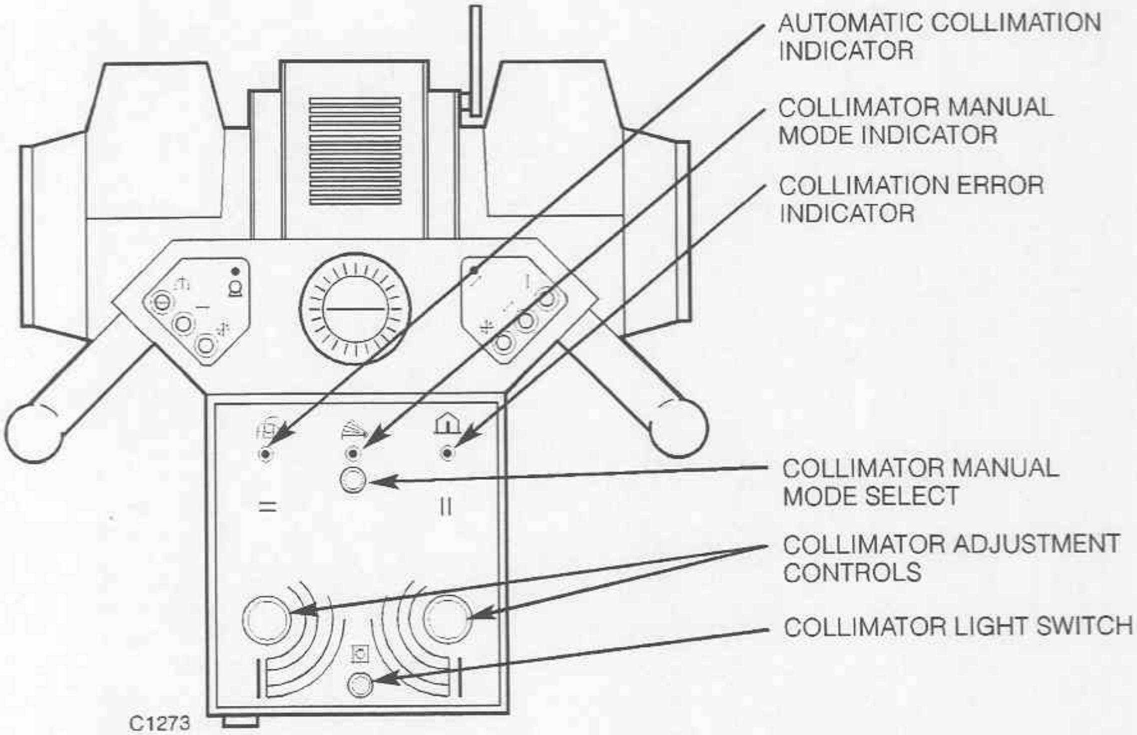

AUTOMATIC COLLIMATION INDICATOR
COLLIMATOR MANUAL MODE INDICATOR
COLLIMATION ERROR INDICATOR
COLLIMATOR MANUAL MODE SELECT
COLLIMATOR ADJUSTMENT CONTROLS
COLLIMATOR LIGHT SWITCH
C1273

FIGURE 4–4 ADJUSTING THE FIELD SIZE

NOTE

Automatic collimator mode occurs when there is a cassette in the bucky tray, the x-ray tube is within the 36" to maximum SID range, and the central ray is vertical.

2. If a cassette is in the bucky and the x-ray tube is not within the SID range, then the conditions for automatic collimation are not met. The manual collimation indicator illuminates.

3. If the collimator is in the automatic mode and it is desired to collimate to a field smaller than the inserted cassette, proceed as follows:

   a. Press the collimator manual mode select switch to select the manual mode of collimation. The collimator manual mode indicator illuminates.

   b. Press the collimator light switch to turn on the collimator light, and view the opening of the collimator vanes in both axes relative to the cassette size.

   c. Several scales are provided to indicate the correct settings of the collimator adjustment controls for the collimator vanes for several cassette sizes at several SIDs, so that the light beam and the x-ray field can be limited to the desired cassette size in both axes.

   d. Adjust size as required using the collimator adjustment controls.

MAKING AN EXPOSURE

There are several options available when ready to make an exposure. Exposures may be made with or without the bucky and may be made in automatic or manual mode. All options are outlined in the paragraphs that follow.

Automatic Operation

1. Ensure power is ON to the system.

NOTE

The portion of this procedure outlined in steps 2 through 5 does not represent a required sequence. It may be beneficial to alter this portion of the sequence depending upon the situation.

2. Place a cassette in the appropriate film device: bucky tray, tabletop or lateral cassette holder. Refer to **Inserting a Cassette**.

3. Position the patient on the table. Refer to **Positioning the Patient on the Tabletop**.

4. Position the x-ray tube and select the desired SID. Refer to **Positioning the X-ray Tube**.

5. At the generator control panel (**Figure 4–5**), select the desired generator settings as follows:

   a. Select the desired technique by pressing the technique selection switch (○ or ○) corresponding to the desired technique to be used (indicator illuminated).

   b. Press the desired Anatomically Programmed Radiography (**APR**) switch (indicator illuminated).

   c. Select the desired screen speed (indicator illuminated) using the screen switches (●, ●, and ●).

   d. The exposure factors programmed for the selected APR are now selected.

6. Activate pre-exposure by pressing the prep key (○) or activate exposure sequence by pressing the exposure key (▯).

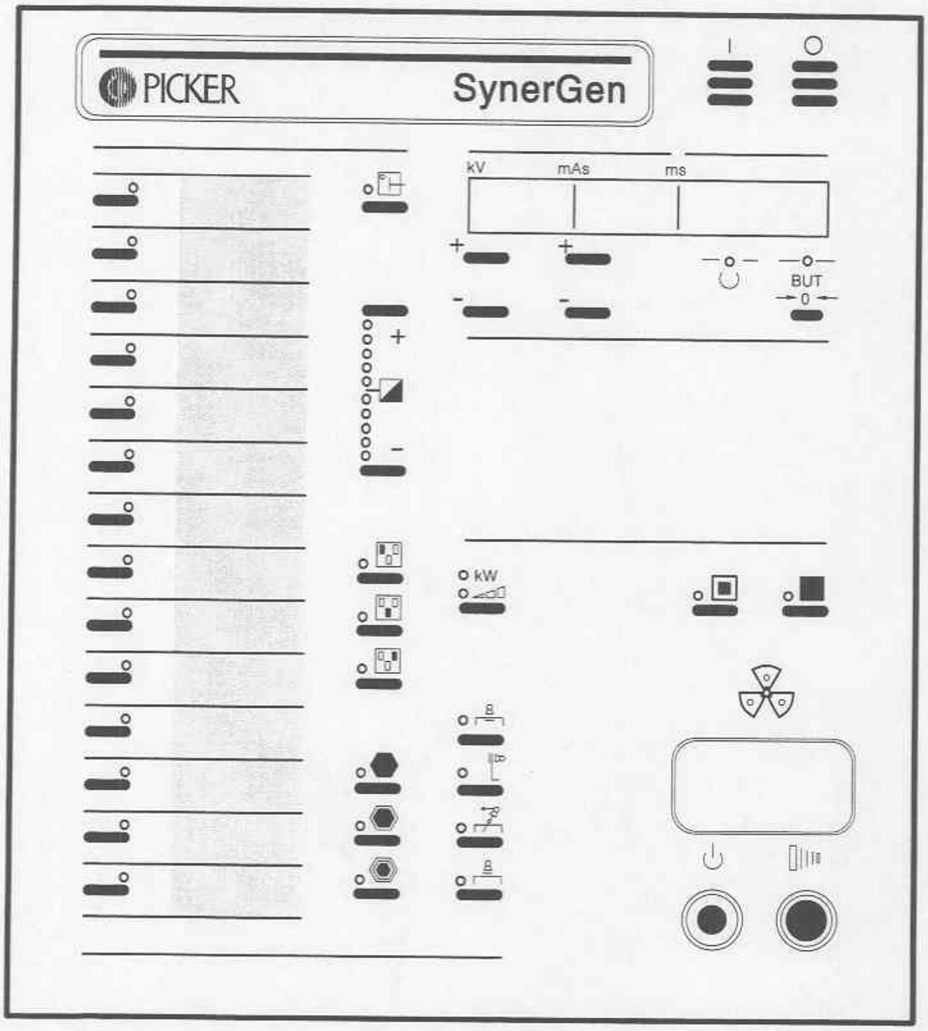
NOTE

If only the exposure key is pressed, then the exposure preparation and exposure release automatically occur in sequence.

7. After the anode is up to speed, the exposure can be initiated immediately by pressing the exposure key (▯).

Manual Operation

For specific applications, the programmed combination of exposure factors can be temporarily modified manually in either of two modes. The two available modes are with and without Automatic Exposure Control (AEC).



C1210

FIGURE 4–5 GENERATOR CONTROL PANEL

Exposures with Automatic Exposure Control

1. Ensure power is ON to the system.

NOTE

The portion of this procedure outlined in steps 2 through 6 do not representative a required sequence. It may be beneficial to alter this portion of the sequence depending upon the situation.

2. Place a cassette in the appropriate film device: bucky tray, tabletop or lateral cassette holder. Refer to **Inserting a Cassette**.

3. Position the patient on the table. Refer to **Positioning the Patient on the Tabletop**.

4. Position the x-ray tube and select the desired SID. Refer to **Positioning the X-ray Tube**.

5. If desired, adjust collimator manually. Refer to **Adjusting the Field Size**.

6. At the generator control panel (**Figure 4–5**), select the desired generator settings as follows:

   a. Select Automatic Exposure Control (AEC) by pressing the AEC (○⊞) switch to ON (indicator illuminated).

   b. Manually set the kV value using the **kV +** and **–** switches.

   c. The mAs value is determined automatically by the AEC function.

   d. The following exposure factors may be temporarily modified:

      1. maximum exposure value (mAs), using the mAs + and – switches;

      2. kilovoltage (kV), using the kV + and – switches;

      3. density, using the density (-◪) + and – switches;

      4. measuring field, using the three field switches (○⊡, ○⊡, and ○⊡);

      5. screen speed, using the screen switches (○●, ○●, and ○◉);

      6. focal spot size, using the focal spot size switches (○▣ and ○■).

7. Activate pre-exposure by pressing the prep key (-○-) or activate the exposure sequence by pressing the exposure key (▯).

NOTE

If only the exposure key is pressed, then the exposure preparation and exposure release automatically occur in sequence.

8. After the anode is up to speed, the exposure can be initiated immediately by pressing the exposure key (▥).

Exposures without Automatic Exposure Control

1. Ensure power is ON to the system.

NOTE

> The portion of this procedure outlined in steps 2 through 6 do not representative a required sequence. It may be beneficial to alter this portion of the sequence depending upon the situation.

2. Place a cassette in the appropriate film device: bucky tray, tabletop or lateral cassette holder. Refer to **Inserting a Cassette**.
3. Position the patient on the table. Refer to **Positioning the Patient on the Tabletop**.
4. Position the x-ray tube and select the desired SID. Refer to **Positioning the X-ray Tube**.
5. If desired, adjust collimator manually. Refer to **Adjusting the Field Size**.
6. At the generator control panel (**Figure 4–5**), select the desired generator settings as follows:
   a. Ensure Automatic Exposure Control (AEC) is OFF by pressing the AEC (∘⊞) switch to OFF (indicator extinguished).
   b. Manually set the kV value using the **kV +** and **–** switches.
   c. Manually set the mAs value using the **mAs +** and **–** switches.
   d. The following exposure factors may be temporarily modified:
      1. maximum exposure value (mAs), using the **mAs +** and – switches;
      2. kilovoltage (kV), using the **kV +** and – switches;
      3. focal spot size, using the focal spot size switches (∘▣ and ∘■).

7. Activate pre-exposure by pressing the prep key (-ȣ-) or activate the exposure sequence by pressing the exposure key (▯|||).

NOTE

If only the exposure key is pressed, then the exposure preparation and exposure release automatically occur in sequence.

8. After the anode is up to speed, the exposure can be initiated immediately by pressing the exposure key (▯|||).

ERROR DISPLAYS

In the event of a malfunction in the generator system or of operator error, an error code is displayed in the ms display. The Clinix VP4 Generator then blocks further operation, to prevent damage to the system as a whole.

Refer to the section entitled **ERROR MESSAGES** later in this manual.

CHANGING APR SELECTIONS

1. Select the APR (Anatomically Programmed Radiography) to be changed by pressing the appropriate **APR** switch (indicator illuminated).
2. Make changes as desired and the selected **APR** indicator will flash.
3. When changes are complete, press and hold the **BUT** switch until the APR indicator stops flashing to store the new configuration of the APR selection.

OPERATOR MAINTENANCE

INTRODUCTION

The purpose of this section is to provide the user with general and preventive maintenance that should be performed to ensure safe and adequate operation of the equipment.

GENERAL MAINTENANCE

The maintenance items necessary to ensure conformance to the manufacturer's specifications are contained in the paragraph entitled **User's Maintenance Schedule** in this section. The specified maintenance should be performed at the prescribed intervals.

As noted in FDA document 75-8005, A PRACTITIONER'S GUIDE TO THE DIAGNOSTIC X-RAY EQUIPMENT STANDARD, "It is up to the practitioner to have his x-ray equipment maintained according to the schedule furnished by the manufacturer to ensure compliance with the standard for the life of the equipment. Failure to follow the manufacturer's maintenance instructions could relieve the manufacturer of responsibility for continued compliance."

PREVENTIVE MAINTENANCE

The preventive maintenance procedures required to ensure operational integrity and safety of the equipment are contained in the applicable User's Maintenance Schedule. It is the owner/users' responsibility to perform preventive maintenance at the specified intervals or arrange for such service with an authorized Service Representative.

CLEANING

Prior to cleaning, ensure that the system is turned off, that the emergency OFF switch or safety switch is actuated, and that no liquids can penetrate into the equipment.

CAUTION

DO NOT USE WATER FOR CLEANING. WATER CAUSES SHORT CIRCUITS IN THE ELECTRICAL PORTION OF THE SYSTEM, AND CORROSION IN THE MECHANICAL COMPONENTS.

DO NOT USE CORROSIVES, SOLVENTS OR ABRASIVE CLEANING MATERIALS.

1. Clean painted and plastic surfaces only with a cloth and common household cleansers.
2. Dry-wipe with a clean, dry, lint-free cloth.
3. Clean chrome-plated parts by wiping with a clean, dry, lint-free cloth.

DISINFECTION

Prior to disinfecting, ensure that the system is turned off, that the emergency OFF switch or safety switch is actuated, and that no liquids can penetrate into the equipment.

CAUTION

FOR SAFETY REASONS, NO SPRAY DISINFECTANTS MAY BE USED.

All components, including accessories and connecting cables, may be disinfected only by wiping with a disinfectant solution. Please contact Picker International if detailed information is needed concerning appropriate disinfection materials.

The equipment must be well covered with plastic sheets during room disinfection.

Recommendations and instructions regarding the use of disinfectants and methods of disinfection may be derived from the most recent rules and guidelines concerning disinfection and explosion safety.

RUSTPROOFING

Tubestand Longitudinal Bearing Tracks

1. On the control arm, press the longitudinal brake release switch (↔) and move the tubestand to one end of its travel.

2. Spray the exposed area of the upper and lower tubestand bearing tracks with Erol Rustproofing Spray (P/N 448663). Refer to **Figure 5–1**.

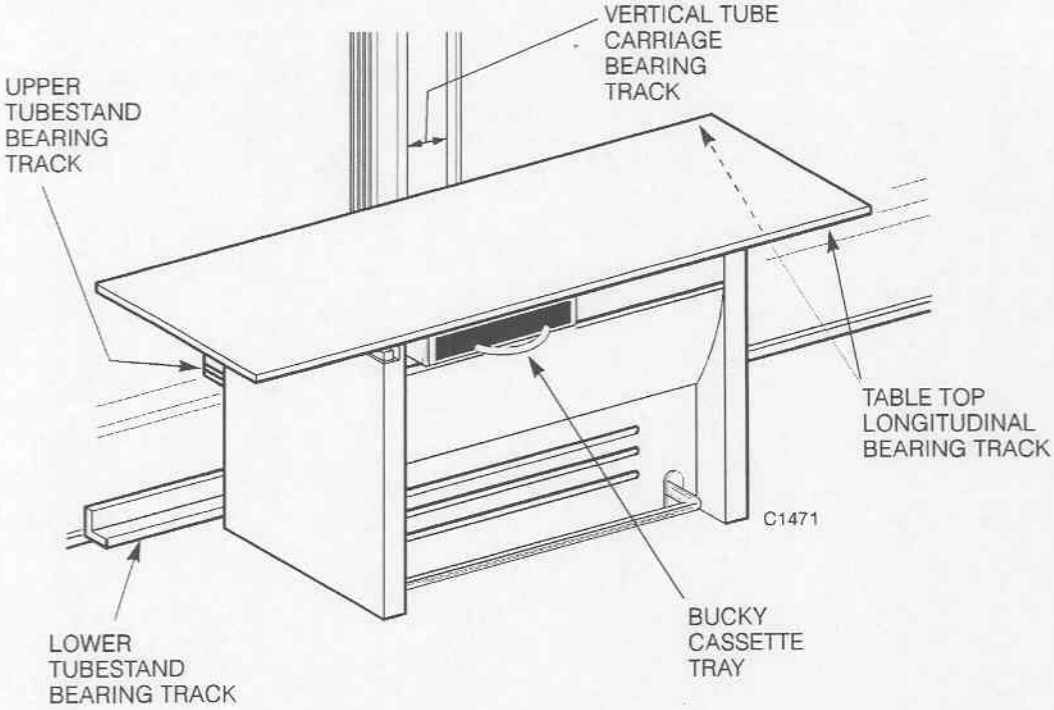

VERTICAL TUBE CARRIAGE BEARING TRACK
UPPER TUBESTAND BEARING TRACK
TABLE TOP LONGITUDINAL BEARING TRACK
C1471
LOWER TUBESTAND BEARING TRACK
BUCKY CASSETTE TRAY

FIGURE 5–1 RUSTPROOFING AND LUBRICATION POINTS

3. Move the tubestand away from the end of its travel to expose the unsprayed area of the bearing tracks.

4. Spray the remaining portion of the upper and lower tubestand bearing tracks.

Table Top Transverse Roller Tracks

1. Step on the brake release pedal bar and move the table top to one end of its transverse travel.

2. Spray the exposed area of the head end and foot end table top roller tracks with Erol Rustproofing Spray (P/N 448663). Refer to **Figure 5–1**.

3. Move the table top to the other end of its transverse travel to expose the unsprayed area of the roller tracks.

4. Spray the remaining portion of the head end and foot end table top roller tracks.

LUBRICATION

Vertical Tube Carriage Bearing Tracks

1. On the control arm, press the vertical brake release switch (↕) and raise the control arm to the top of its travel.

2. Apply a small amount of silicon grease (P/N 061777) to a cloth or paper towel.

3. Lightly coat the interior surface of the exposed length of each vertical tube carriage bearing track with the silicon grease. Refer to **Figure 5–1**.

4. Press the vertical brake release switch and lower the control arm to expose the unlubricated area of the bearing tracks.

5. Lightly coat the interior surface of the remaining length of each vertical tube carriage bearing track with silicon grease.

Table Top Longitudinal Bearing Tracks

1. Step on the brake release pedal bar and move the table top to the longitudinal stop at the foot end of the table.

2. Apply a small amount of silicon grease (P/N 061777) to a cloth or paper towel.

3. Lightly coat the surface of the exposed length of each table top longitudinal bearing track with the silicon grease. Refer to **Figure 5–1**.

4. Step on the brake release pedal bar and move the table top to the longitudinal stop at the head end of the table.

5. Lightly coat the surface of the remaining length of each table top longitudinal bearing track with the silicon grease.

Bucky Cassette Tray Slides

1. Pull the bucky cassette tray out to its fully extended position.

2. Apply a small amount of silicon grease (P/N 061777) to a cloth or paper towel.

3. Lightly coat the surface of the entire length of each bucky cassette tray slide with the silicon grease. Refer to **Figure 5–1**.

4. Close the bucky cassette tray.

USER MAINTENANCE SCHEDULE

The required maintenance/inspections for the Clinix VP4 X-ray System are provided in **Tables 5–1** through **5–4**.

TABLE 5–1 TABLE MAINTENANCE SCHEDULE

Item	Time Interval	Comments
Operator Maintenance		
Table Top Attenuation	1 mo.	Inspect the front cover for any damage, alterations or deviations which could alter the original x-ray attenuation characteristics.
Mechanical/Electrical		
Bucky Carriage	12 mo.	Check for ease of movement over the entire range of travel and check for noisy bearings, interference or binding. Check bucky brake over entire range. Energized brake must hold bucky securely, adjust as necessary.
Tabletop Movement	12 mo.	Operate tabletop over the entire range (transverse and longitudinal) and check for drift, noisy bearings, or hang ups.
Tabletop Brakes	12 mo.	Position tabletop at extreme and intermediate tabletop positions and check that the brakes are operational; adjust if necessary.
Rustproofing	12 mo.	Refer to the paragraph entitled **Rustproofing** contained in this section.
Lubrication	12 mo.	Refer to the paragraph entitled **Lubrication** in this section.

TABLE 5–2 X-RAY CONTROL MAINTENANCE SCHEDULE

Item	Time Interval	Comments
Operator Maintenance		
Visual Inspection	1 mo.	Inspect and confirm all warning labels, certification labels, and all control panel identifiers are legible and have not been defaced or removed.
Visual Exposure Indicator	1 mo.	Confirm that all visual exposure indicators (LEDs) function only during exposures.
Audible Exposure Indicator	1 mo.	Confirm that audible exposure indicator functions only during exposures.
Radiation Leakage	1 mo.	Inspect for physical damage which could affect radiation shielding and proper beam limiting device functions.
Beam Direction and SID	1 mo.	Confirm that the tube angle indicator and SID indicators are functioning. Indicators are located on the tube support arm.
X-ray Exposure Switch	1 mo.	Confirm that the exposure switch requires continuous pressure to maintain an exposure and that release of the switch terminates the exposure.
Indicator Lights at Power-on	Daily	Check at power-on.
Mechanical/Electrical		
High-Tension Generator	12 mo.	Check for leakage.
High-Tension Cable Terminations	12 mo.	High-tension cables to be regreased by qualified service technician.
X-ray Control Calibration	12 mo.	Calibration to be performed by qualified service technician.
Replace CU PCB NVRAM	72 mo.	CU PCB NVRAM to be replaced by qualified service technician.

TABLE 5–3 COLLIMATOR MAINTENANCE SCHEDULE

Item	Time Interval	Comments
Operator Maintenance		
Leakage Radiation	1 mo.	Visually and manipulatively inspect the collimator and its attachment to the x-ray tube housing for physical damage, loose components, or wear which could affect the leakage radiation.
Mechanical/Electrical		
Routine Maintenance	6 mo.	Verify that all components and hardware are secure and functional, clean and lubricate as specified in the Collimator service manual.
Electrical Calibration	6 mo.	Refer to the Collimator service manual.

TABLE 5–4 STORAGE MAINTENANCE SCHEDULE

Item	Time Interval	Comments
Rustproofing	6 mo.	Refer to the paragraph entitled **Rustproofing** contained in this section.
Lubrication	6 mo.	Refer to the paragraph entitled **Lubrication** contained in this section.
Regrease High-Tension Cables	6 mo.	High-tension cables to be regreased by qualified service technician.
Replace CU PCB NVRAM	72 mo.	CU PCB NVRAM to be replaced by qualified service technician.

ERROR MESSAGES

INTRODUCTION

The purpose of this section is to provide the user with the error messages associated with the Clinix VP4 X-Ray system. The error codes, when displayed, appear in the ms portion of the exposure control display. Refer to **Controls and Indicators** section.

If an exposure is interrupted by premature release of the exposure key, the message E200 is displayed in the ms display. Press any key to render the system operational again.

ERROR MESSAGES

The error codes are three-digit code numbers prefixed with a letter (E, H, or L). Error messages may occur at any time during operation. When an error is displayed, refer to **Table 6–1**, find the matching error code in the table, and perform the corrective action provided for the given error.

TABLE 6–1 CLINIX VP4 ERROR CODES

Error Code	Meaning	Corrective Action
E108	Undefined stop mode.	Remove power from system and re-apply power.
E200	Premature release of exposure key.	Press any switch to return to operational status.
H952	Allowable prep to exposure time exceeded.	Release prep switch sooner.
H953	AEC backup time reached.	Press BUT switch to reset and return to operational status.
L900	Illegal time selected.	Select time value within allowable range.
L901	Illegal mA selected.	Select mA value within allowable range.

NOTE

Codes that appear on the control panel that are not defined in **Table 6–1** require corrective action by a qualified service technician.

PREPARATION FOR TRANSPORT

INTRODUCTION

The Clinix VP4 system must be secured according to the following procedure before the shelter is transported. To secure the system for transport, the transverse tubearm assembly must be removed and placed in a special transport mounting device and the vertical column must be removed and secured to special mounting platforms on the baseplate. The following procedure describes how to perform these operations.

CAUTION

THE CLINIX VP4 SYSTEM MUST BE SECURED ACCORDING TO THE FOLLOWING PROCEDURE BEFORE THE SHELTER IS TRANSPORTED. FAILURE TO DO SO WILL RESULT IN DAMAGE TO THE EQUIPMENT.

PROCEDURE

1. Move the column to the head end of the table.
2. Move the tabletop all the way toward the foot end (right).
3. Place the foam pad on the head end of the tabletop as indicated in **Figure 7–1**.
4. Place the tube/collimator transport fixture on the foam pad as shown in **Figure 7–1**.

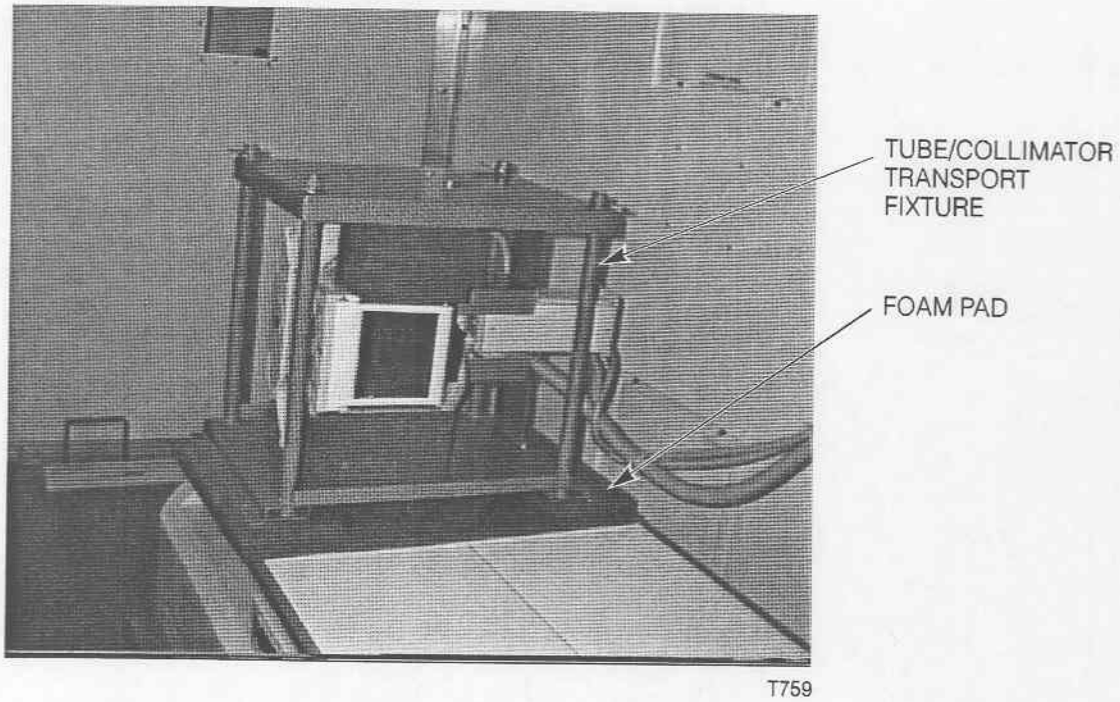

TUBE/COLLIMATOR
TRANSPORT
FIXTURE
FOAM PAD
T759

FIGURE 7–1 TUBE/COLLIMATOR TRANSPORT FIXTURE

5. Rotate the tube/collimator assembly so that the collimator is aimed toward the foot end as shown in **Figure 7–2**.

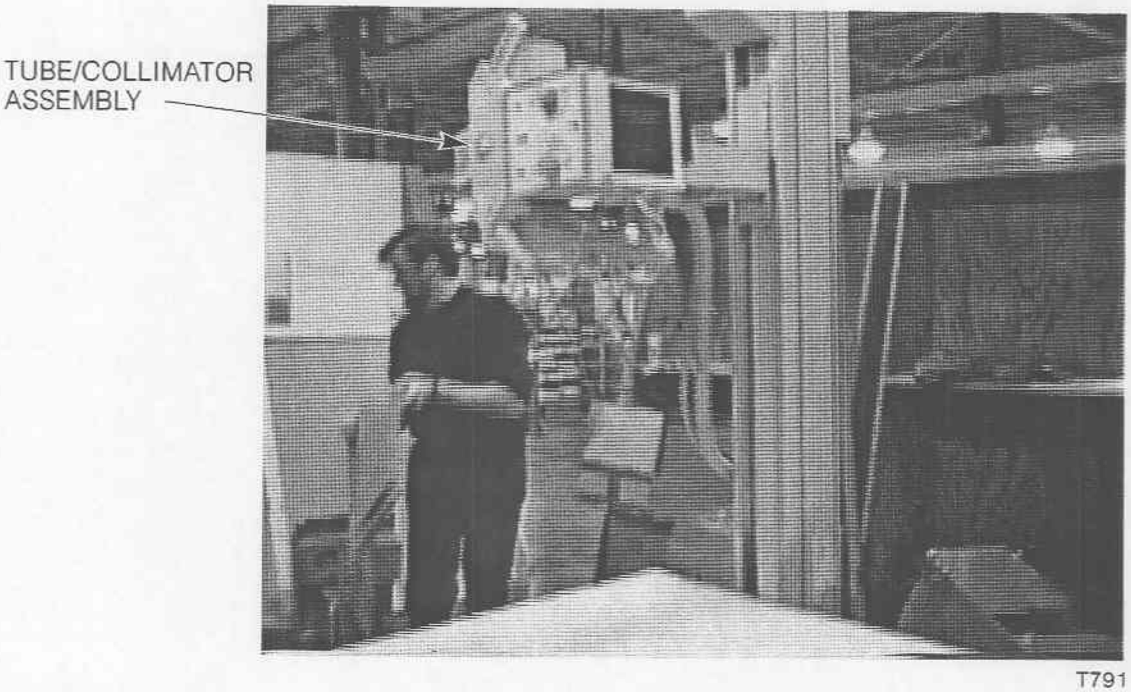

TUBE/COLLIMATOR
ASSEMBLY
T791

FIGURE 7–2 TUBEHEAD POSITIONING FOR TRANSPORT

6. Lower the tube/collimator assembly into the transport as shown in **Figure 7–3**.

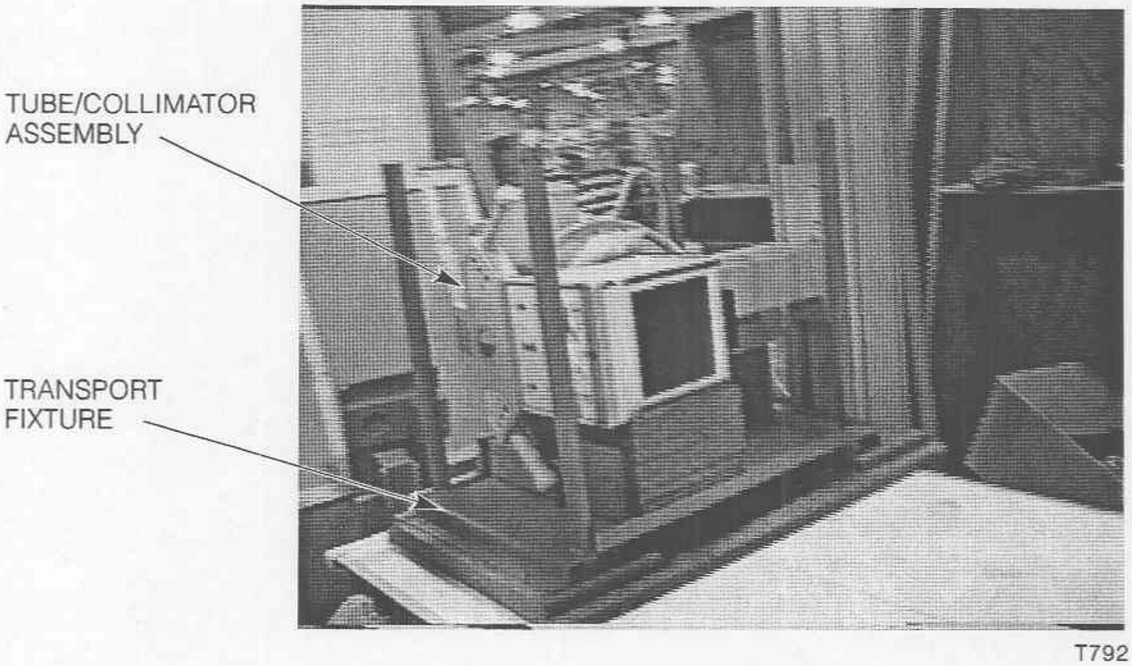


FIGURE 7–3 TUBE/COLLIMATOR PLACEMENT IN FIXTURE

7. Remove the counterweight support pin and bracket from the back of the vertical column (refer to **Figure 7–4**).

8. Insert the long end of the counterweight through the hole in the back of the vertical column and into the counterweight carriage inside the column.

NOTE

It may be necessary to move the tubearm up or down slightly to get the hole in the counterweight carraige to align with the hole in the column.

9. Remove four screws and lock washers securing the tubearm to the vertical carriage and push the tubearm in to its fully retracted position.

10. Move the tabletop forward away from the column.

11. Place the cover on the tube/collimator transport fixture.

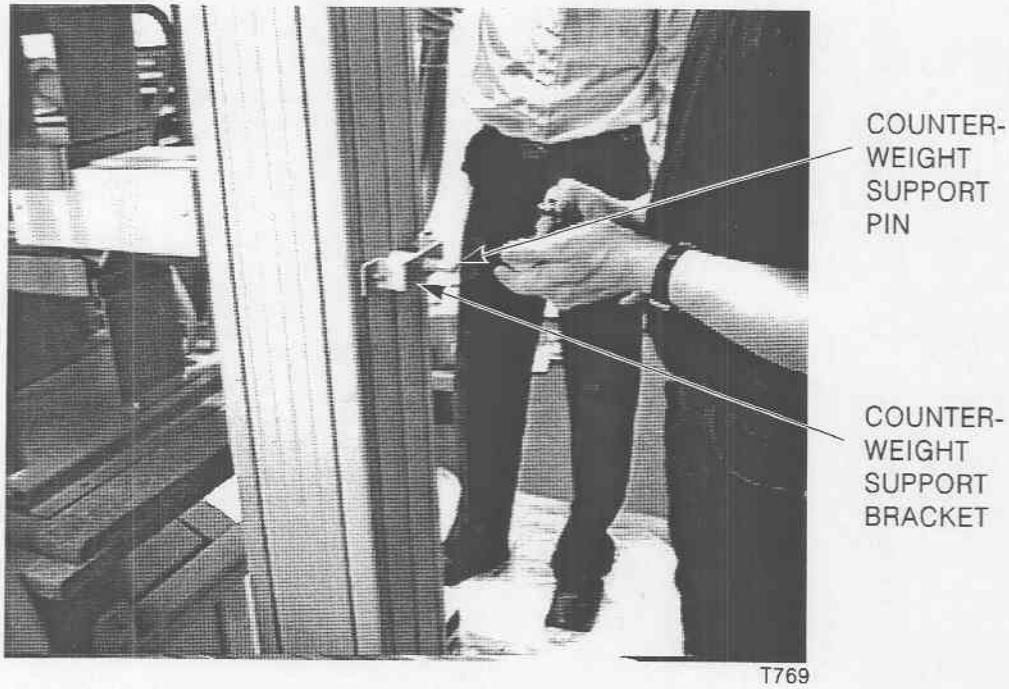

COUNTER-
WEIGHT
SUPPORT
PIN
COUNTER-
WEIGHT
SUPPORT
BRACKET
T769

FIGURE 7–5 COUNTERWEIGHT RESTRAINT PIN

12. Place one plastic spacer ring over each corner post and insert a clip in the top of each post as shown in **Figure 7–5**.

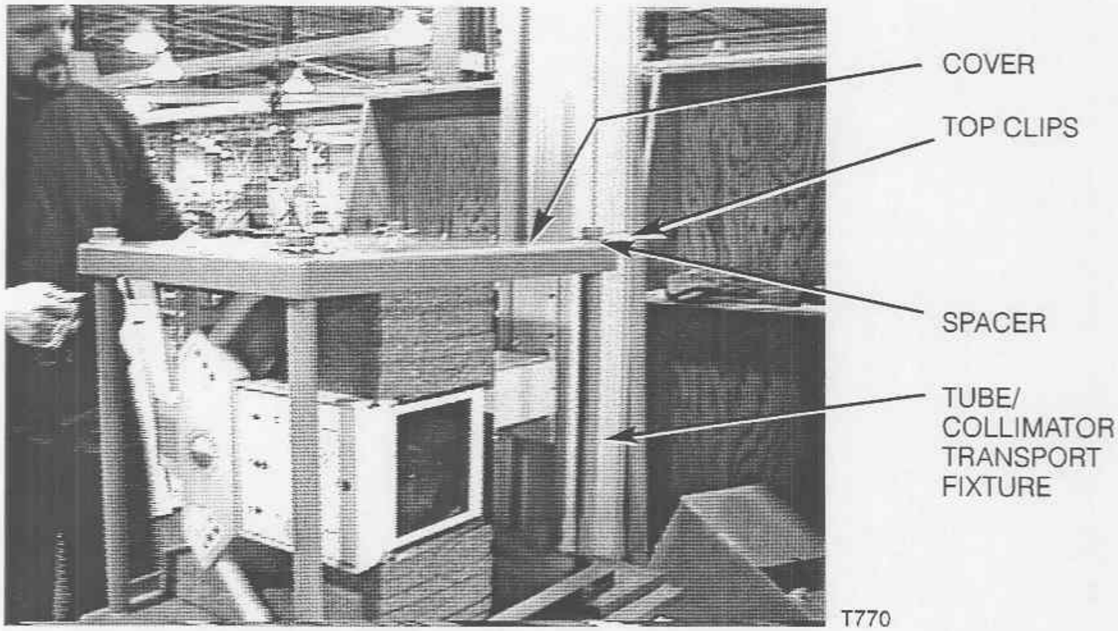

COVER
TOP CLIPS
SPACER
TUBE/
COLLIMATOR
TRANSPORT
FIXTURE
T770

FIGURE 7–4 COVER ON TRANSPORT FIXTURE

13. Position the vertical carriage lock so that the notch is over the setscrew as shown in **Figure 7–6**.

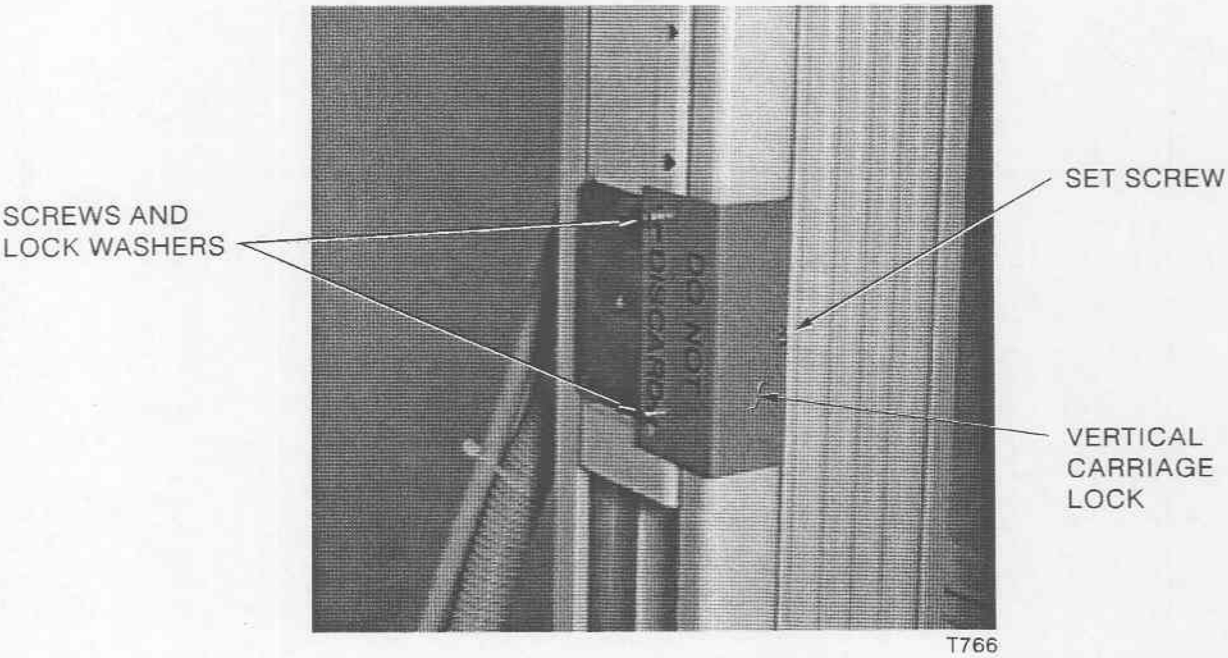

SCREWS AND
LOCK WASHERS
SET SCREW
VERTICAL
CARRIAGE
LOCK
DO NOT
DISCARD
T766

FIGURE 7–6 VERTICAL CARRIAGE RESTRAINT

14. Secure the vertical carriage lock in place using two screws and two lock washers.

15. Loosen the hole cover at the rear of the table and remove cable slack as shown in **Figure 7–7**.

16. Position the column all the way to the right on its travel (foot end).

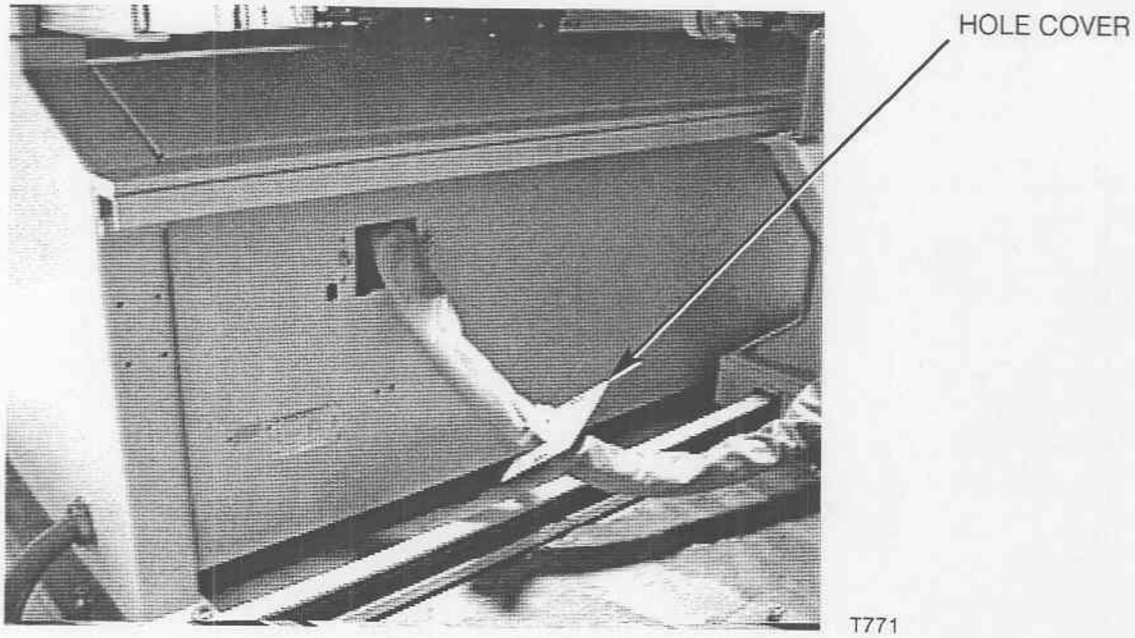

HOLE COVER
T771

FIGURE 7–7 REMOVING HOLE COVER

17. Position the column support bracket to the baseplate as shown in **Figure 7–8** and secure in place using four screws and four lock washers.

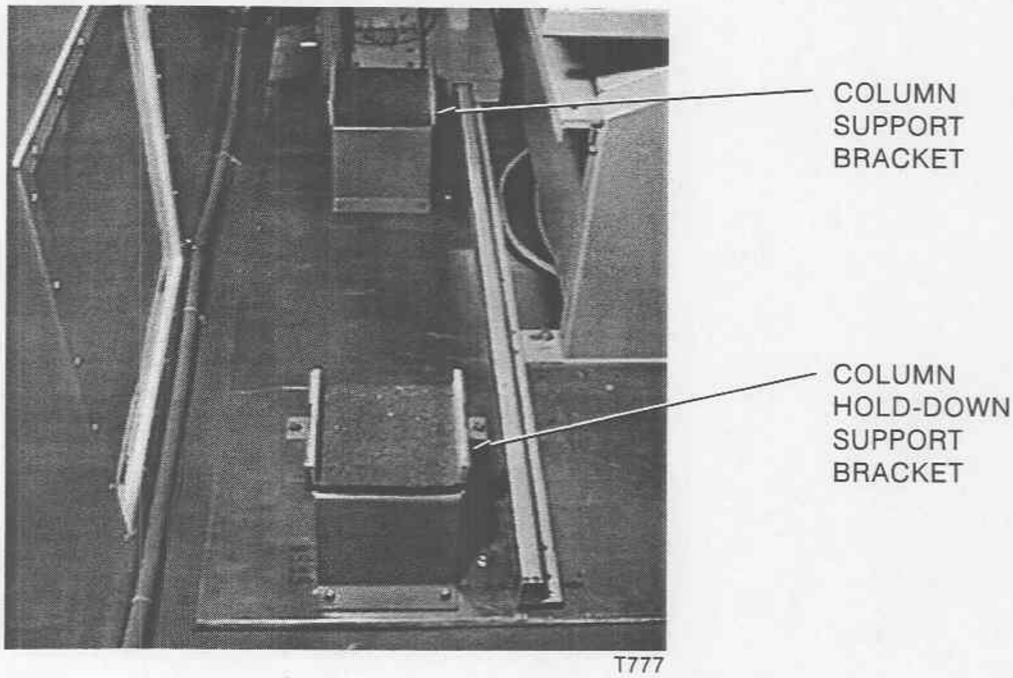

COLUMN
SUPPORT
BRACKET
COLUMN
HOLD-DOWN
SUPPORT
BRACKET
T777

FIGURE 7–8 VERTICAL COLUMN TRANSPORT SUPPORTS

18. Position the column hold-down support bracket to the baseplate as shown in **Figure 7–8** and secure in place using four screws and four lock washers.

19. Lower the column hinge bracket and secure it to the column base using four screws and four lock washers as shown in **Figure 7–9**.

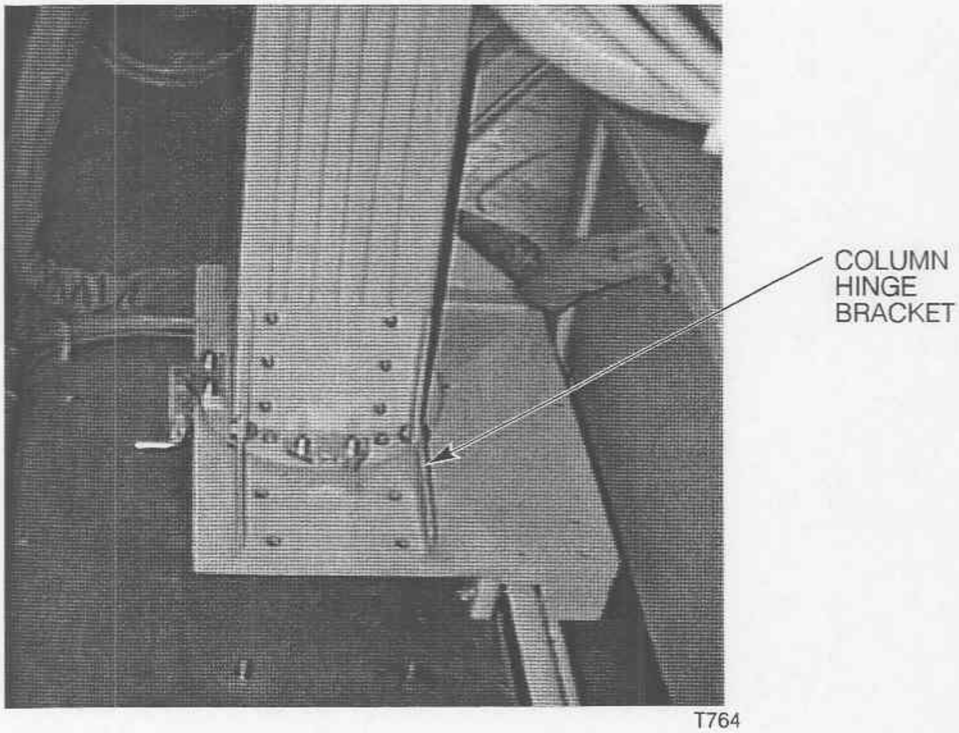


FIGURE 7–9 VERTICAL COLUMN HINGE INSTALLATION

20. Remove four screws that secure the column to the column base.

WARNING

THE COLUMN IS HEAVY. THEREFORE, USE EXTREME CAUTION WHILE LOWERING THE COLUMN ONTO THE COLUMN SUPPORT BRACKETS, OTHERWISE, PERSONAL INJURY MAY RESULT.

CAUTION

ENSURE THAT THE CABLES DO NOT BECOME TRAPPED BETWEEN THE COLUMN AND THE SUPPORT BRACKETS. OTHERWISE, DAMAGE TO THE CABLES MAY RESULT.

21. While making sure that the cables do not come between the vertical column and the support brackets, lay the column down on the support brackets as shown in **Figure 7–10**.

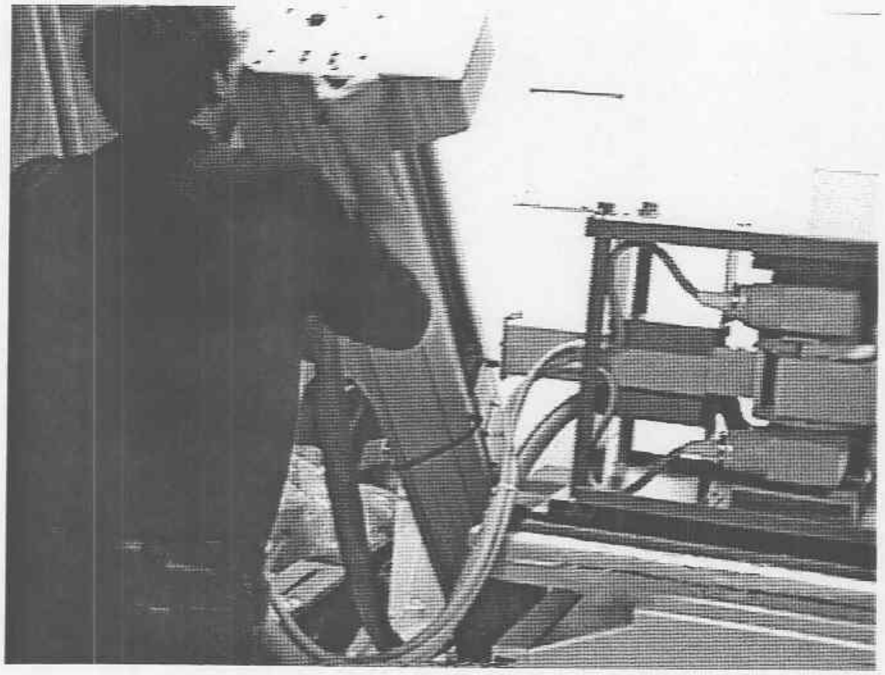


FIGURE 7–10 LOWERING THE VERTICAL COLUMN

22. Position the column hold-down bracket to the hold-down support bracket over the column as shown in **Figure 7–11**.

23. Secure the column hold-down bracket in place using two screws and two lock washers.

WARNING

THE LOADED TRANSPORT FIXTURE IS HEAVY. THEREFORE, USE EXTREME CAUTION WHILE LIFTING OR MOVING THE TRANSPORT FIXTURE, OTHERWISE, PERSONAL INJURY MAY RESULT.

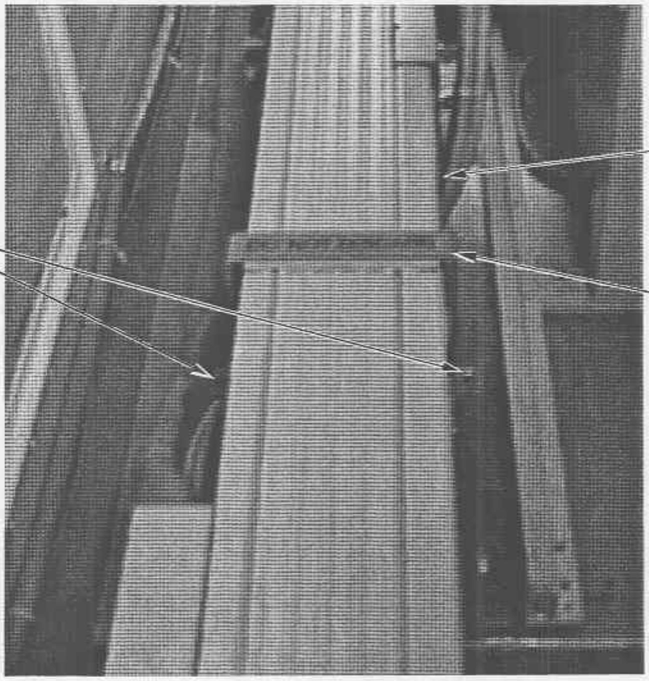

COLUMN
SCREWS AND LOCKWASHER
COLUMN HOLD-DOWN BRACKET
T760

FIGURE 7–11 INSTALLING COLUMN HOLD-DOWN BRACKET

24. Lift the tube/collimator transport fixture off of the table and set it on the baseplate near the table base as shown in **Figure 7–12**.

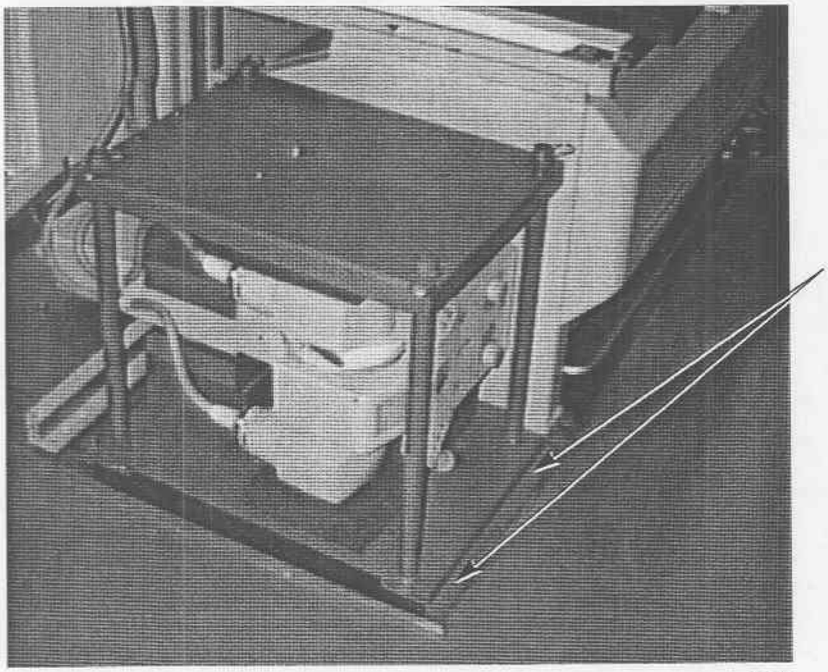

TUBE/COLLIMATOR TRANSPORT FIXTURE MOUNTING BOLTS (TWO ON OTHER SIDE)
T775

FIGURE 7–12 TRANSPORT DEVICE PLACEMENT

25. Secure the fixture to the baseplate using four screws and four lock washers.

26. Move the tabletop to the middle position.

27. At the rear of the bucky, hook bucky restraint cord to the guide rail as shown in **Figure 7–13**.

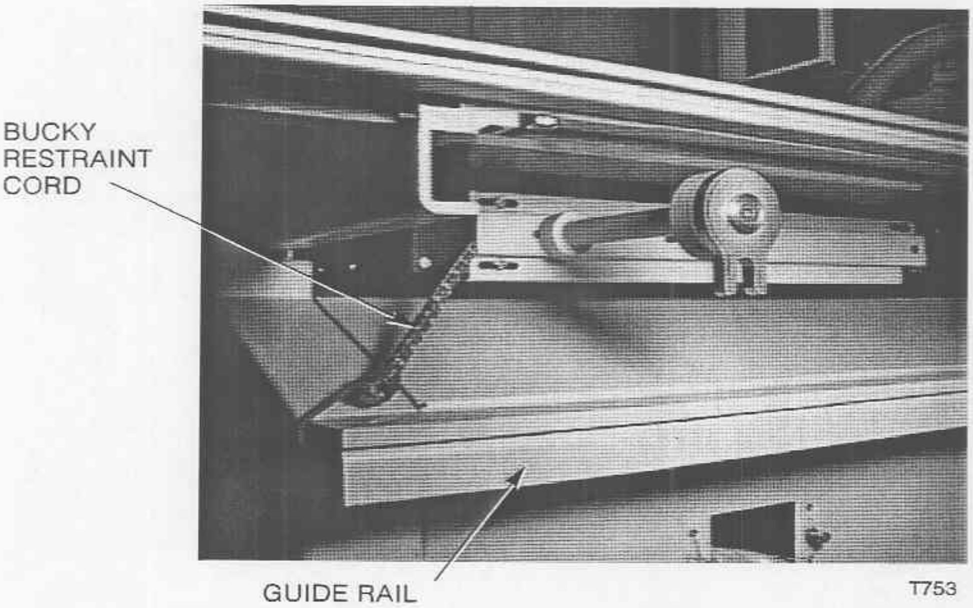


FIGURE 7–13 BUCKY RESTRAINT CORD

28. At the front of the bucky, loosen the locking device and move to the left as shown in **Figure 7–14**.

29. Secure the locking device in place.

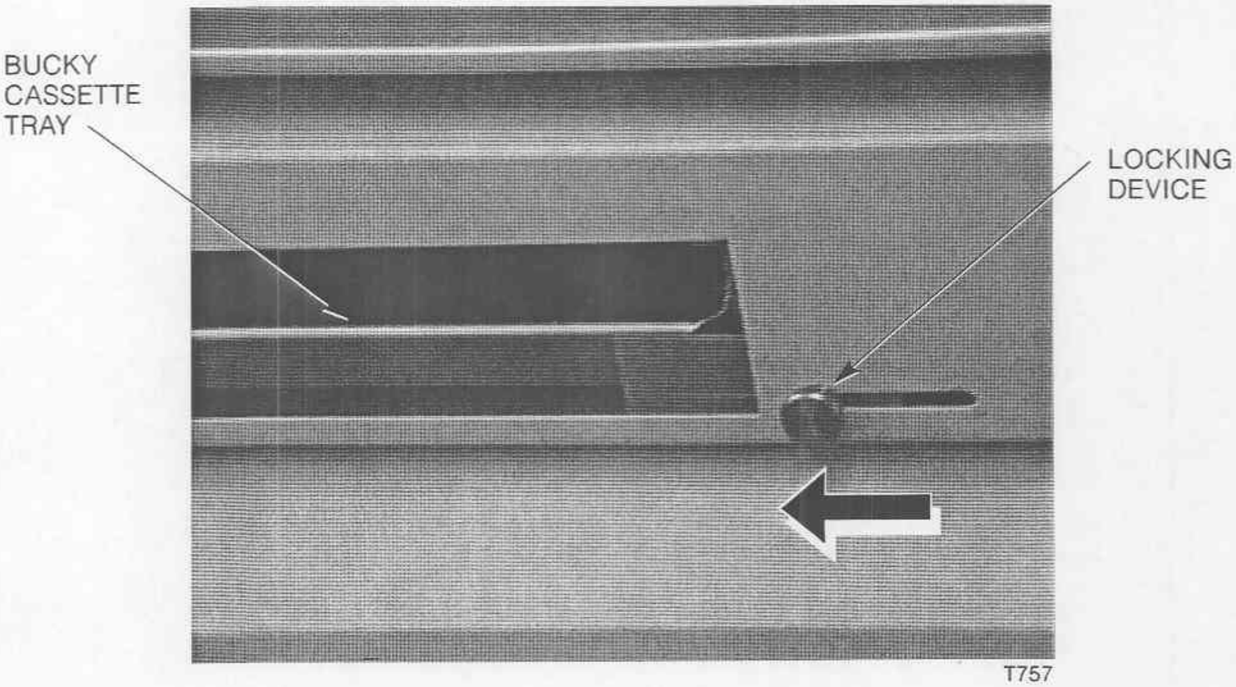

BUCKY
CASSETTE
TRAY
LOCKING
DEVICE
T757

FIGURE 7–14 SECURING BUCKY CASSETTE TRAY

FEDERAL MAINTENANCE REQUIREMENTS

FEDERAL REGULATORY MAINTENANCE

Maintenance procedures necessary to ensure conformance to the manufacturer's specifications are contained in the recommended Schedule of Maintenance supplied with your equipment. This maintenance should be performed by qualified trained service personnel at the prescribed intervals as noted on the Schedule of Maintenance.

As noted in (FDA) 75-8005, A PRACTITIONER'S GUIDE TO THE DIAGNOSTIC X-RAY EQUIPMENT STANDARD: "It is up to the practitioner to have x-ray equipment maintained according to the schedule furnished by the manufacturer to ensure compliance with the standard for the life of the equipment. Failure to follow the manufacturer's maintenance instructions could relieve the manufacturer of responsibility for continued compliance."

END OF MANUAL

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PICKER

System Installation Manual

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Clinix VP4 Table/ SynerGen

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TX008:SIM

Part No.
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NOTICE

The information contained in this manual conforms with the configuration of the equipment as of the date of manufacture. Revisions to the equipment subsequent to the date of manufacture will be addressed in service updates distributed to the Picker Technical Service Organization.

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Diagnostic X-ray Systems

RADIATION WARNING

X-RAY AND GAMMA-RAYS ARE DANGEROUS TO BOTH OPERATOR AND OTHERS IN THE VICINITY UNLESS ESTABLISHED SAFE EXPOSURE PROCEDURES ARE STRICTLY OBSERVED.

THE USEFUL AND SCATTERED BEAMS CAN PRODUCE SERIOUS OR FATAL BODILY INJURIES TO ANY PERSONS IN THE SURROUNDING AREA IF USED BY AN UNSKILLED OPERATOR. ADEQUATE PRECAUTIONS MUST ALWAYS BE TAKEN TO AVOID EXPOSURE TO THE USEFUL BEAM, AS WELL AS TO SCATTERED RADIATION RESULTING FROM THE PASSAGE OF RADIATION THROUGH MATTER.

THOSE AUTHORIZED TO OPERATE, PARTICIPATE IN, OR SUPERVISE THE OPERATION OF THE EQUIPMENT MUST BE THOROUGHLY FAMILIAR AND COMPLY COMPLETELY WITH THE CURRENT ESTABLISHED SAFE EXPOSURE FACTORS AND PROCEDURES DESCRIBED IN PUBLICATIONS, SUCH AS: SUBCHAPTER J OF TITLE 21 OF THE CODE OF FEDERAL REGULATIONS, "DIAGNOSTIC X-RAY SYSTEMS AND THEIR MAJOR COMPONENTS," AND THE NATIONAL COUNCIL ON RADIATION PROTECTION (NCRP) NO. 102, "MEDICAL X-RAY AND GAMMA-RAY PROTECTION FOR ENERGIES UP TO 10 MEV-EQUIPMENT DESIGN AND USE," AS REVISED OR REPLACED IN THE FUTURE.

THOSE RESPONSIBLE FOR THE PLANNING OF X-RAY AND GAMMA-RAY EQUIPMENT INSTALLATIONS MUST BE THOROUGHLY FAMILIAR AND COMPLY COMPLETELY WITH NCRP NO. 49, "STRUCTURAL SHIELDING DESIGN AND EVALUATION FOR MEDICAL OF X-RAYS AND GAMMA-RAYS OF ENERGIES UP TO 10 MEV," AS REVISED OR REPLACED IN THE FUTURE.

FAILURE TO OBSERVE THESE WARNINGS MAY CAUSE SERIOUS OR FATAL BODILY INJURIES TO THE OPERATOR OR THOSE IN THE AREA.

Diagnostic X-ray Systems

MECHANICAL - ELECTRICAL WARNING

ALL OF THE MOVEABLE ASSEMBLIES AND PARTS OF THIS EQUIPMENT SHOULD BE OPERATED WITH CARE AND ROUTINELY INSPECTED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS CONTAINED IN THE EQUIPMENT MANUALS.

ONLY PROPERLY TRAINED AND QUALIFIED PERSONNEL SHOULD BE PERMITTED ACCESS TO ANY INTERNAL PARTS. LIVE ELECTRICAL TERMINALS ARE DEADLY; BE SURE LINE DISCONNECT SWITCHES ARE OPENED AND OTHER APPROPRIATE PRECAUTIONS ARE TAKEN BEFORE OPENING ACCESS DOORS, REMOVING ENCLOSURE PANELS, OR ATTACHING ACCESSORIES.

DO NOT REMOVE FLEXIBLE HIGH TENSION CABLES FROM X-RAY TUBE HOUSING OR HIGH TENSION GENERATOR AND/OR ACCESS COVERS FROM GENERATOR UNTIL THE MAIN AND AUXILIARY POWER SUPPLIES HAVE BEEN DISCONNECTED.

FAILURE TO COMPLY WITH THE FOREGOING MAY RESULT IN SERIOUS OR FATAL BODILY INJURIES TO THE OPERATOR OR THOSE IN THE AREA.

ELECTRICAL GROUNDING INSTRUCTIONS

THE EQUIPMENT MUST BE GROUNDED TO AN EARTH GROUND BY A SEPARATE CONDUCTOR. THE NEUTRAL SIDE OF THE LINE IS NOT TO BE CONSIDERED THE EARTH GROUND. ON EQUIPMENT PROVIDED WITH A LINE CORD, THE EQUIPMENT MUST BE CONNECTED TO A PROPERLY GROUNDED, THREE-PIN RECEPTACLE. DO NOT USE A THREE-TO-TWO PIN ADAPTER.

INSTALLATION AND ENVIRONMENT

EXCEPT FOR INSTALLATIONS REQUIRING CERTIFICATION BY THE MANUFACTURER PER FEDERAL STANDARDS, SEE THAT A RADIATION PROTECTION SURVEY IS MADE BY A QUALIFIED EXPERT IN ACCORDANCE WITH NCRP 102, SECTION 7, AS REVISED OR REPLACED IN THE FUTURE. PERFORM A SURVEY AFTER EVERY CHANGE IN EQUIPMENT, WORKLOAD, OR OPERATING CONDITIONS WHICH MIGHT SIGNIFICANTLY INCREASE THE PROBABILITY OF PERSONS RECEIVING MORE THAN THE MAXIMUM PERMISSIBLE DOSE EQUIVALENT.

TO THE USER OF THIS MANUAL

THE USER OF THIS MANUAL IS DIRECTED TO READ AND CAREFULLY REVIEW THE INSTRUCTIONS, WARNINGS AND CAUTIONS CONTAINED HEREIN PRIOR TO BEGINNING INSTALLATION OR SERVICE ACTIVITIES. WHILE YOU MAY HAVE PREVIOUSLY INSTALLED OR SERVICED EQUIPMENT SIMILAR TO THAT DESCRIBED IN THIS MANUAL, CHANGES IN DESIGN, MANUFACTURE OR PROCEDURE MAY HAVE OCCURRED WHICH SIGNIFICANTLY AFFECT THE PRESENT INSTALLATION OR SERVICE.

THE INSTALLATION AND SERVICE OF EQUIPMENT DESCRIBED HEREIN IS TO BE PERFORMED BY AUTHORIZED, QUALIFIED PICKER INTERNATIONAL PERSONNEL. ASSEMBLERS AND OTHER PERSONNEL NOT EMPLOYED BY NOR DIRECTLY AFFILIATED WITH PICKER INTERNATIONAL TECHNICAL SERVICES ARE DIRECTED TO CONTACT THE LOCAL PICKER OFFICE BEFORE ATTEMPTING INSTALLATION OR SERVICE PROCEDURES.

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EQUIPMENT DESCRIPTION

MAIN TABLE COMPONENTS

The main components of the Clinix VP4 table are pointed out in **Figure 1-1** and are briefly described in the text following. The generator console is shown in **Figure 1-2**.

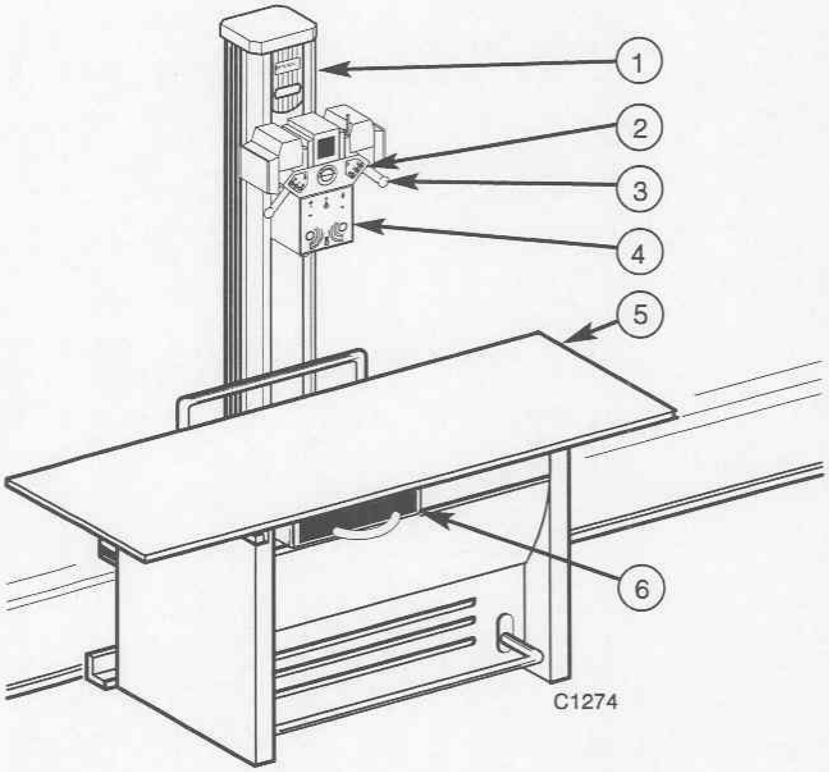


FIGURE 1-1 MAIN TABLE COMPONENTS

1	Integral Tubestand	4	Collimator
2	Control Panel	5	Tabletop
3	X-ray Tube Unit	6	Bucky Unit

TABLE GENERAL DESCRIPTION

The Clinix VP4 table, shown in **Figure 1-1,** is a horizontal radiographic table for a wide range of X-ray examinations with applications in orthopedics, surgery and urology. The microprocessor-controlled SynerGen X-ray generator is mounted inside the table base. A brief description of the SynerGen generator follows the table description.

The Clinix VP4 consists of a table equipped with an under-table bucky and an integrally-mounted tube column. The electronically controlled under-table bucky can be moved longitudinally to facilitate maximum area of possible studies. The X-ray generation system features a 3-field X-ray beam detection system for automatic exposure control (AEC).

The floating, flat tabletop of the bucky table can be locked in place longitudinally and transversely by highly effective, foot-operated mechanical brakes. Movement in both directions can be easily released by means of a conveniently placed brake release pedal bar. The easy floating motion of the tabletop and its wide range of movement ensure convenient patient positioning. A long handlebar behind the tabletop facilitates easy patient movement.

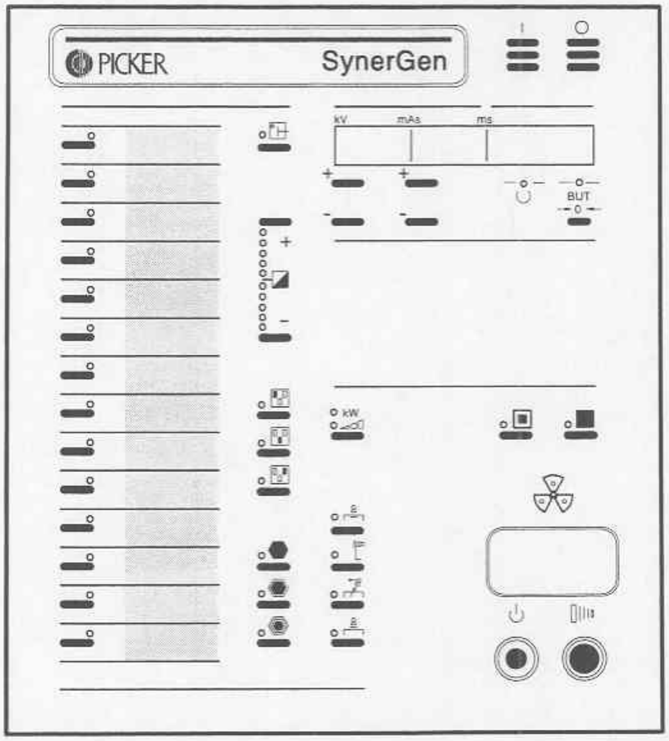
The tube column rides on two rails that are integrally mounted to the table. The X-ray tube, collimator and control handle assembly are suspended from the counterbalanced support arm on the moveable tube column. The tube column and X-ray tube unit can be moved with very little effort and can be held in and position by electromagnetic locks. All control elements on the control arm of the tube column, collimator and bucky table are easily accessible from the front.

SYNERGEN GENERAL DESCRIPTION

The SynerGen is a microprocessor-controlled high frequency inverter driven X-ray generator with a capacity of 40 kW. The SynerGen Generator is suitable for all routine radiographic diagnostic applications and is equipped with automatic exposure control (AEC) coupled to a solid-state pickup mounted in the bucky.

The SynerGen Generator is comprised of two major components: the operator's console and the electronics chassis. The operator's console, shown in **Figure 1-2** provides the user with a convenient method of controlling the functions of the SynerGen generator system. All available controls are present on the Operator Console and are described in detail in the *Clinix VP4/SynerGen Operator's Guide* DRS NO. GX007:F. The electronics chassis, housed inside the table base, contains all of the equipment necessary for operation of the SynerGen Generator. A detailed description of the generator's operation is provided in the the *Synergen Service Manual*, DRS NO. GX007:S.

TABLE TECHNICAL DATA


PICKER
SynerGen
kV
mAs
ms
BUT
kW

C1048

FIGURE 1-2 OPERATOR'S CONSOLE

BUCKY TABLE

Tabletop Dimensions	89" x 30"
Table Height	27.5"
Tabletop to Film Distance	3"

Tabletop Travel from Center Position

Transverse Travel	6"
Longitudinal Travel	±18.5"

Bucky Unit Travel

Film Center to Table Head End (Min.)	13"
Film Center to Table Foot End (Min.)	17"

TUBE COLUMN

Focal Spot Vertical Travel (vertical beam)	47" (max.)
Support Arm Vertical Range	64.5"
Longitudinal Travel	50"
TOTAL WEIGHT	880 lbs.

GENERATOR ELECTRICAL CHARACTERISTICS

INPUT POWER

Line voltage: 208 to 240 ±5% VAC, three-phase

Nominal Line Demand:	Short times:	66 kVA
	No load:	120 VA

OUTPUT POWER

40 kW Output

62 kV @ 640 mA 80 kV @ 500 mA

100 kV @ 400 mA 125 kV @ 320 mA

KV RANGE

40 kV - 125 kV in steps of 1 kV

TUBE CURRENT

50 mA - 640 mA

EXPOSURE INCREMENTS

1 mAs - 2 mAs, ±10% in 4 steps; may be disabled

2.5 mAs - 500 mAs, ±5% in 24 steps

ACCURACY/TOLERANCES

kV: ±4 kV

mAs: ±5% (2.5 - 500 mAs)

±10% (1.0 - 2 mAs)

INSTALLING THE CLINIX VP4

INTRODUCTION

The following procedure describes how to transport the table to the shelter, where to locate it in the shelter and how to mount it.

UNPACKING

1. Cut away the weather-protective foil from around the shipping crate and discard it.
2. Remove the sides and braces from the shipping crate and discard them.
3. Remove the column hold-down brackets.
4. On the hinge at the column base remove the shipping bar (see **Figure 2-1**) that is bolted to the two parts of the column hinge. Discard the shipping bar.

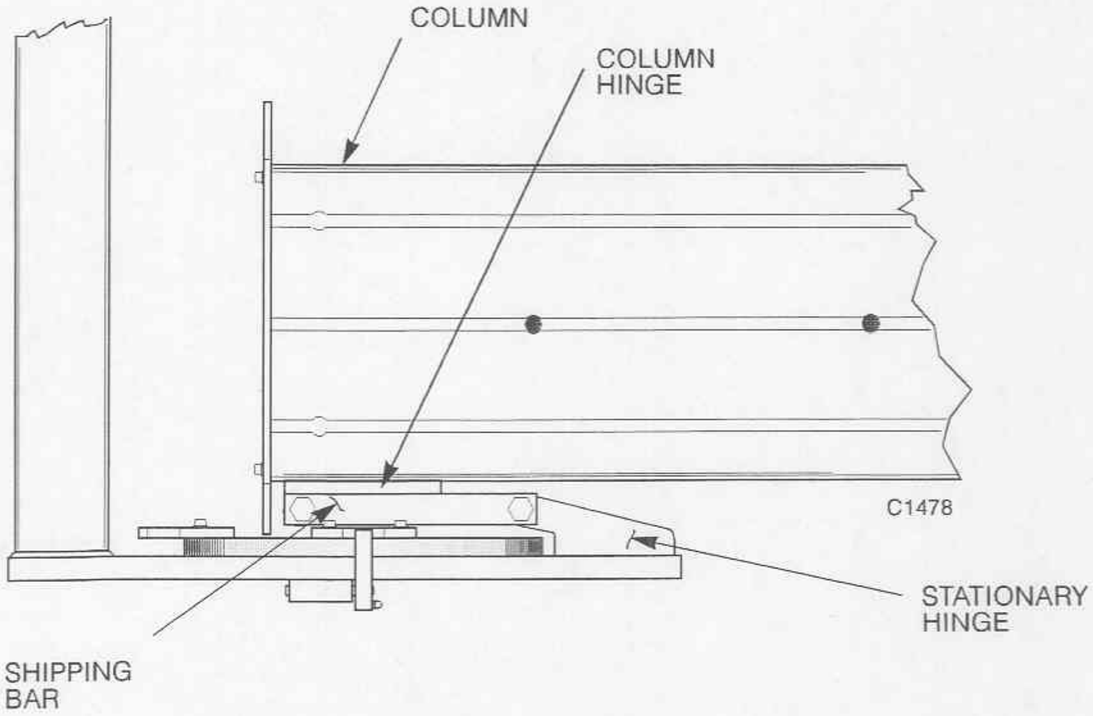


FIGURE 2-1 SHIPPING BAR

5. Move the column toward the head end until the hinge pivot holes of the two parts of the hinge are aligned. Install the two hinge pivot bolts with self-locking nuts. Tighten the bolts snugly but leave them loose enough to allow the hinge to work.

LOCATING SYSTEM IN THE SHELTER

1. Place the mounting template against the back (fixed) wall of the shelter and positioned in the shelter as shown in **Figure 2-2.**
2. Drill holes in the shelter floor according to the template.
3. Install epoxy-potted inserts into the floor holes.
4. Allow the epoxy to fully cure. It should allowed to cure for at least 24 hours.
5. Move the Clinix VP4, on its shipping skid, to the double door side of the shelter. The narrow end of the shipping skid at which the X-ray tube and collimator is located, should butt up against the shelter floor at the double door end of the shelter. Note that the shipping skid is the same height as the shelter floor.
6. Remove the bolts holding the Clinix VP4 to the shipping skid.

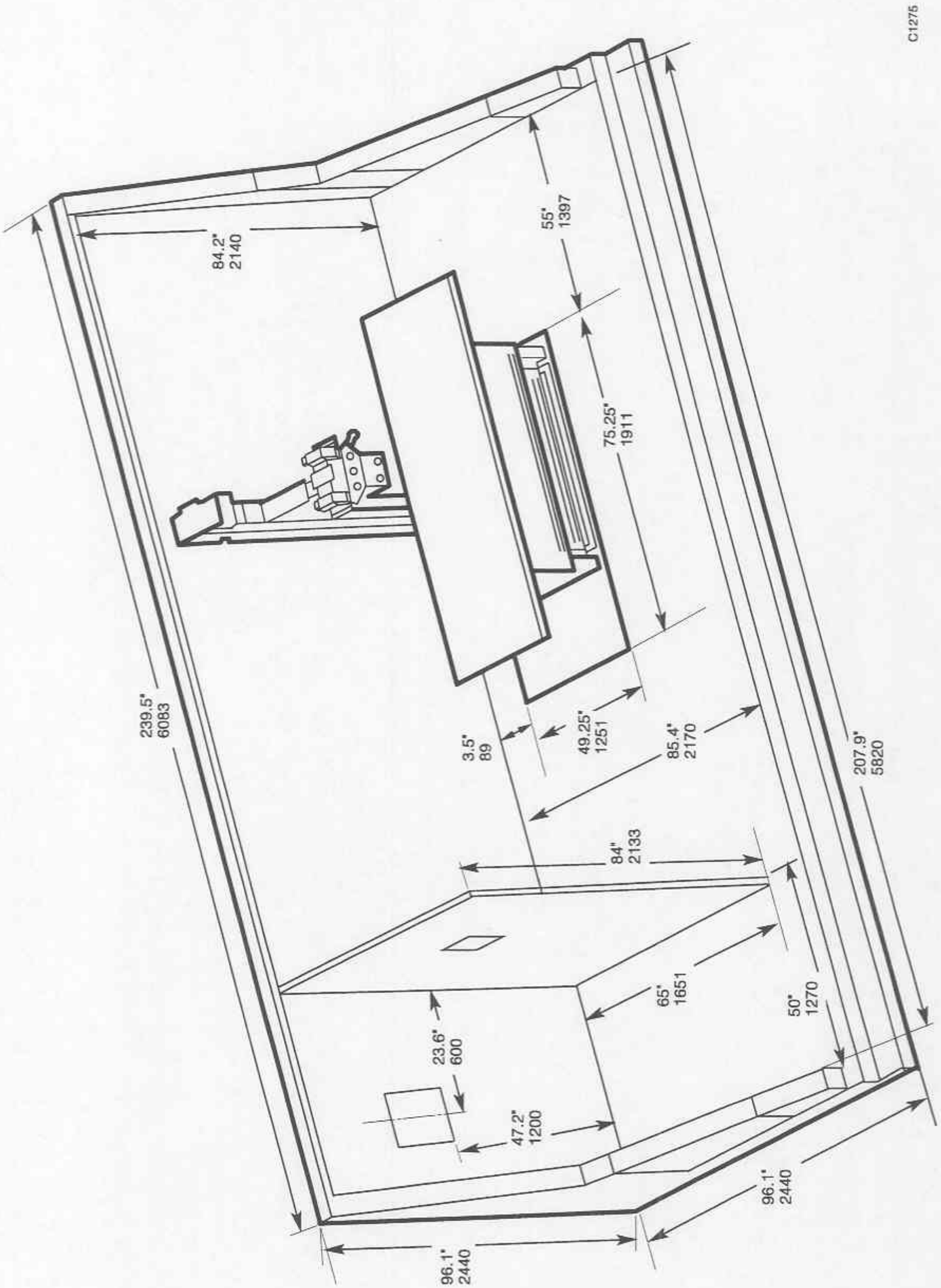

C1275
84.2"
2140
55"
1397
75.25"
1911
239.5"
6083
3.5"
89
49.25"
1251
85.4"
2170
207.9"
5820
84"
2133
65"
1651
50"
1270
23.6"
600
47.2"
1200
96.1"
2440
96.1"
2440

FIGURE 2-2 LOCATION OF TABLE IN SHELTER

INSTALLING THE TABLE TRANSPORT DOLLY

Install the table transport dolly as follows:

1. Remove the four screws that hold the tube/collimator transport fixture to the baseplate (see **Figure 2-3**).

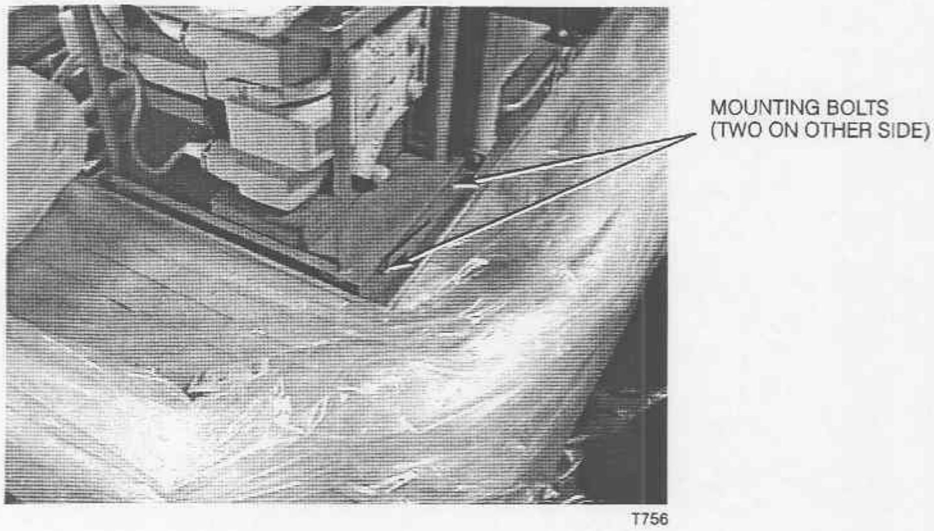

MOUNTING BOLTS
(TWO ON OTHER SIDE)
T756

FIGURE 2-3 TUBE/COLLIMATOR TRANSPORT FIXTURE

2. Slide the tube/collimator shipping fixture approximately four inches away from the end of the table to make room for the transverse beam of the transport dolly as shown in **Figure 2-4**.

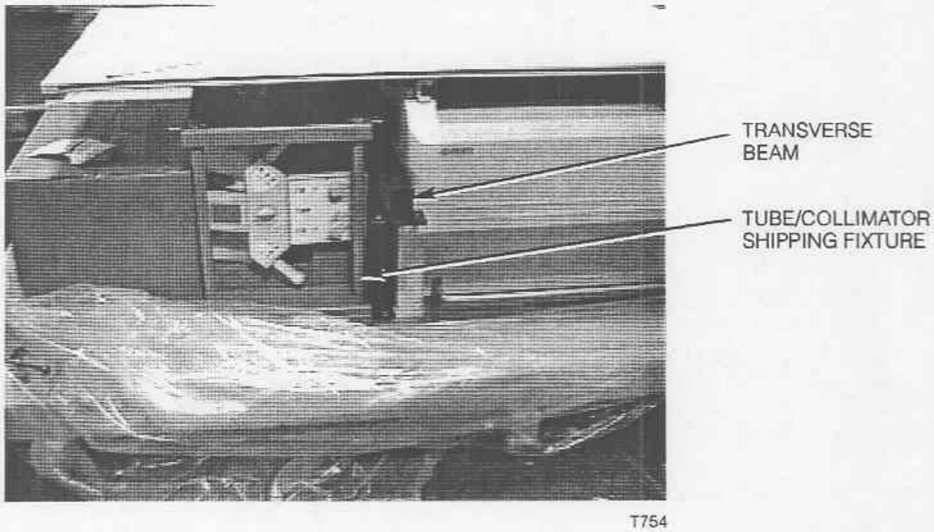

TRANSVERSE
BEAM
TUBE/COLLIMATOR
SHIPPING FIXTURE
T754

FIGURE 2-4 POSITIONING THE TUBE TRANSPORT FIXTURE

3. With the padded side of the beam against the table, install the head-end transverse dolly support beam as shown in **Figure 2-4** and attach it to the baseplate with four M10x130, DIN 933 bolts.
4. In a similar manner, install the foot-end transverse dolly support beam with the padded side of the beam against the table and attach it to the baseplate with four M10x130, DIN 933 bolts as shown in **Figure 2-5**.

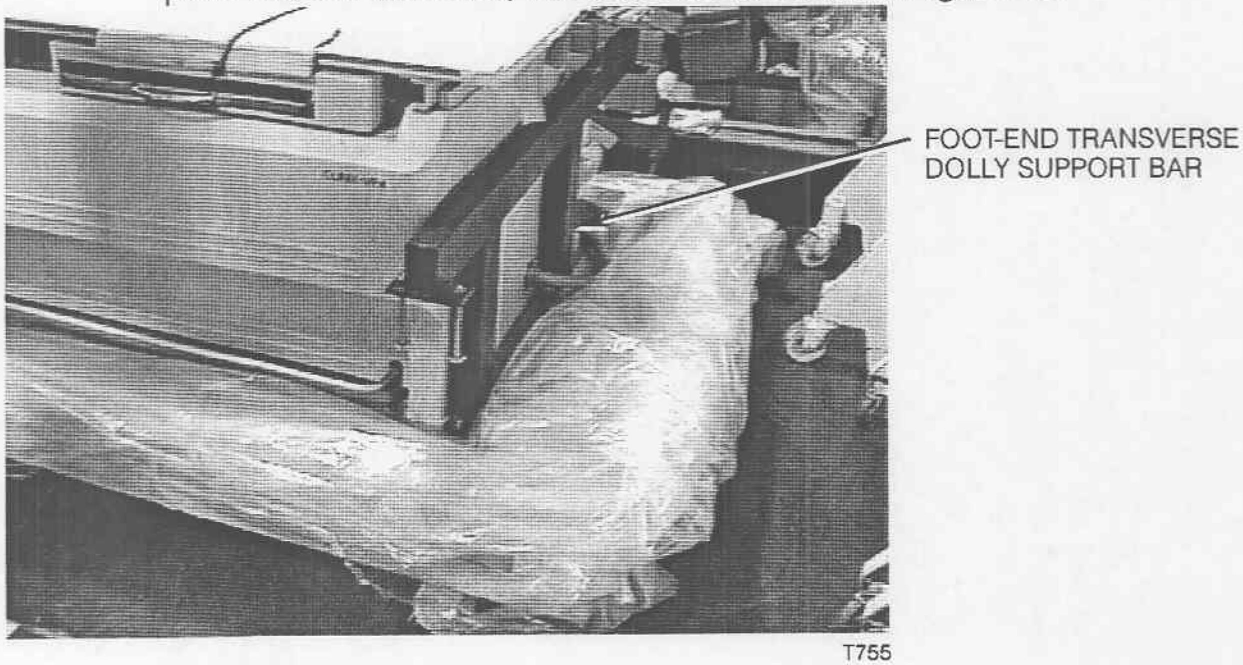


FIGURE 2-5 FOOT-END TRANSVERSE DOLLY SUPPORT BEAM

5. Connect the short longitudinal beam of the transport device to the transverse beams on the front side of the table with four bolts as shown in **Figure 2-6**. Turn the caster screws counterclockwise (using the supplied crank handle) if needed to retract the wheels enough to allow installation of the beam.

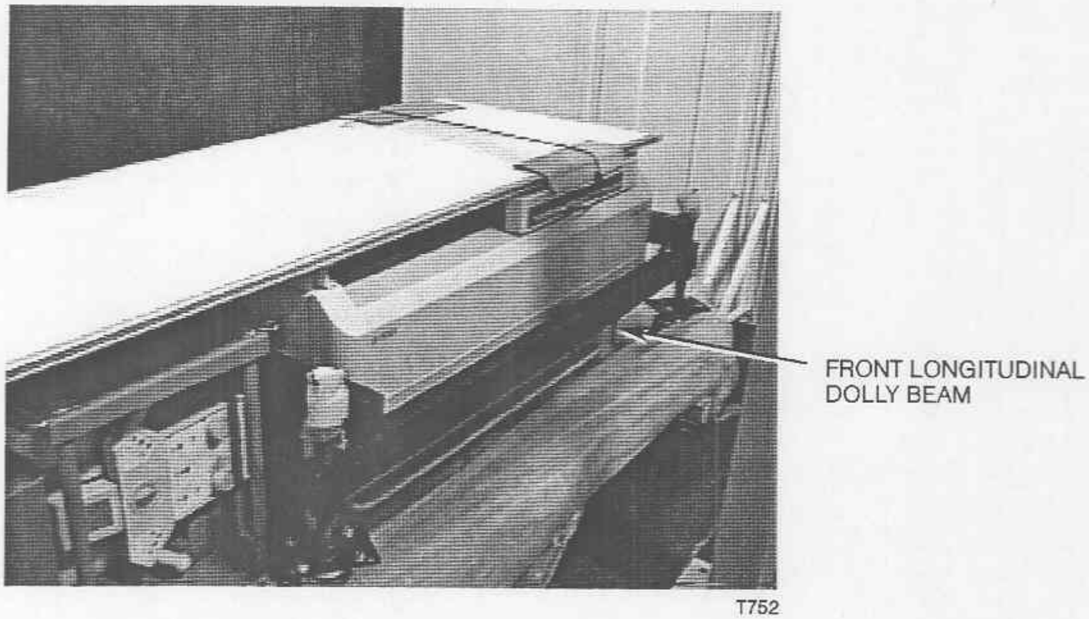


FIGURE 2-6 FRONT LONGITUDINAL DOLLY BEAM

6. Connect the longer longitudinal beam of the transport dolly to the transverse beams on the rear side of the table using four screws as shown in **Figure 2-7**. Turn the caster screws counterclockwise (using the supplied crank handle) if needed to retract the wheels enough to install the beam.

7. Use the crank supplied to turn the caster screws clockwise to lift the Clinix-VP4 and baseplate off the shipping skid.

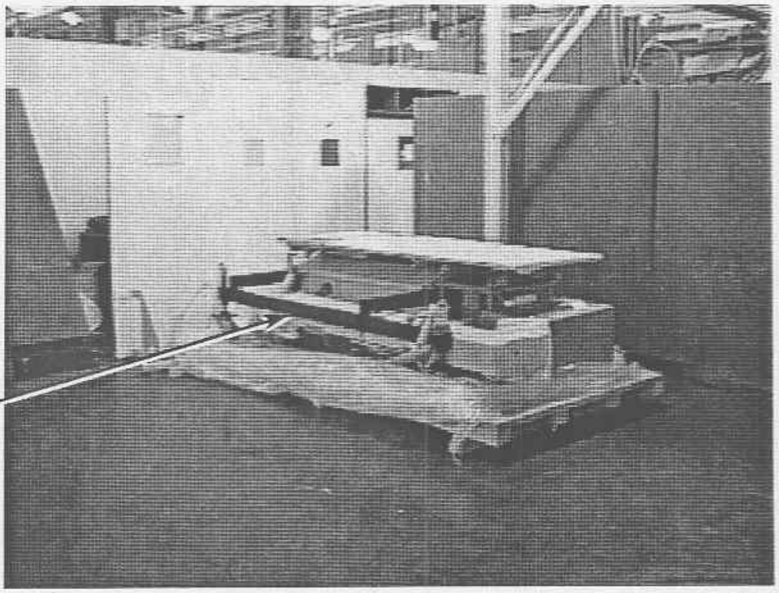


FIGURE 2-7 REAR LONGITUDINAL DOLLY BEAM

INSTALLING THE TABLE

1. Roll the Clinix VP4 on the transport device into the shelter. No ramp should be necessary since the shipping skid is the same height as the shelter floor.

2. Position the baseplate of the Clinix VP4 so that the mounting holes of the baseplate line up with the corresponding epoxy inserts installed in the shelter floor.

3. Use the crank to turn the castor screws counterclockwise to lower the baseplate to the floor.

4. Start the mounting screws in the inserts before the baseplate makes contact with the floor.

Once the system has been bolted in place, proceed to the next section to remove the transport dolly.

REMOVING THE TRANSPORT DOLLY

1. Remove the 4 bolts that attach the front longitudinal dolly beam to the two transverse beams (see **Figure 2-8**) and remove the beam.

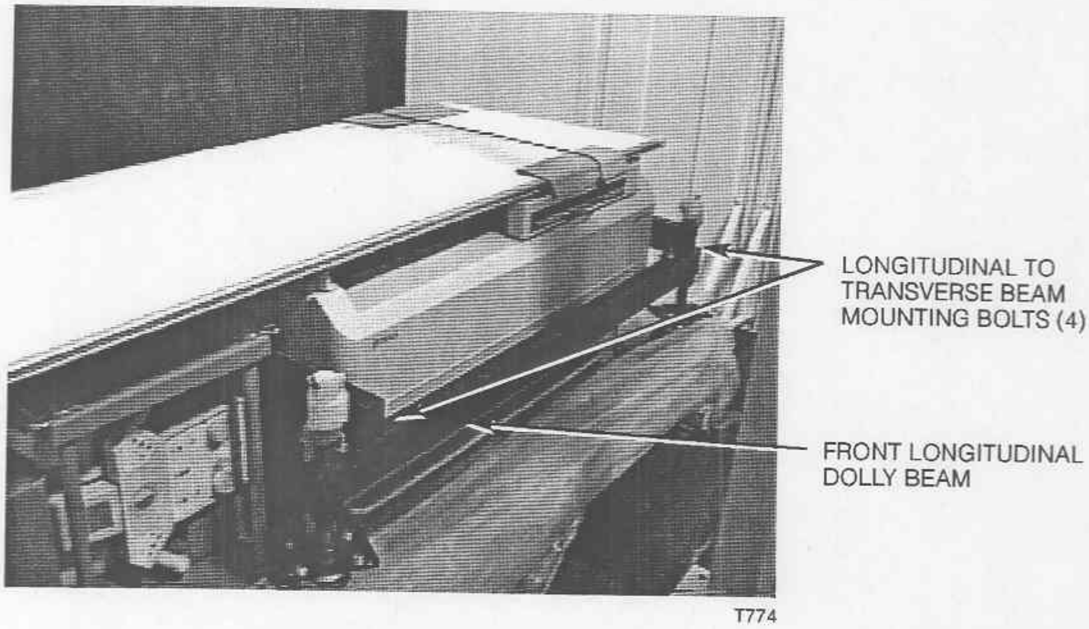

LONGITUDINAL TO
TRANSVERSE BEAM
MOUNTING BOLTS (4)
FRONT LONGITUDINAL
DOLLY BEAM
T774

FIGURE 2-8 FRONT LONGITUDINAL DOLLY BEAM REMOVAL

2. Remove the four bolts that attach the rear longitudinal dolly beam to the two transverse beams and remove the beam (see **Figure 2-9**).

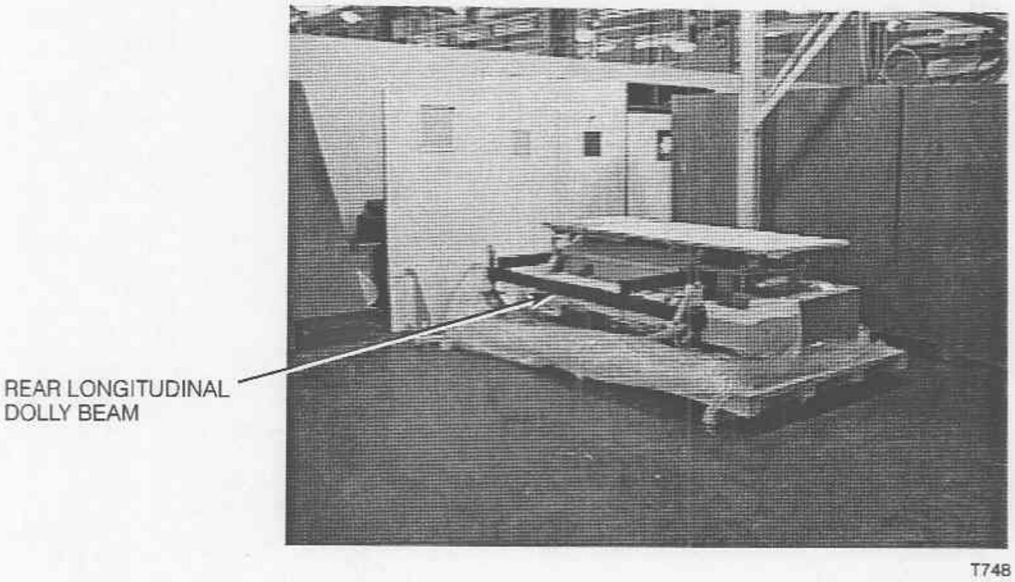

REAR LONGITUDINAL
DOLLY BEAM
T748

FIGURE 2-9 REAR LONGITUDINAL DOLLY BEAM

3. Remove the four bolts that attach the tube/collimator transport fixture to the baseplate (see **Figure 2-10**) and slide the fixture far enough away from the table to allow removal of the transverse dolly beam.

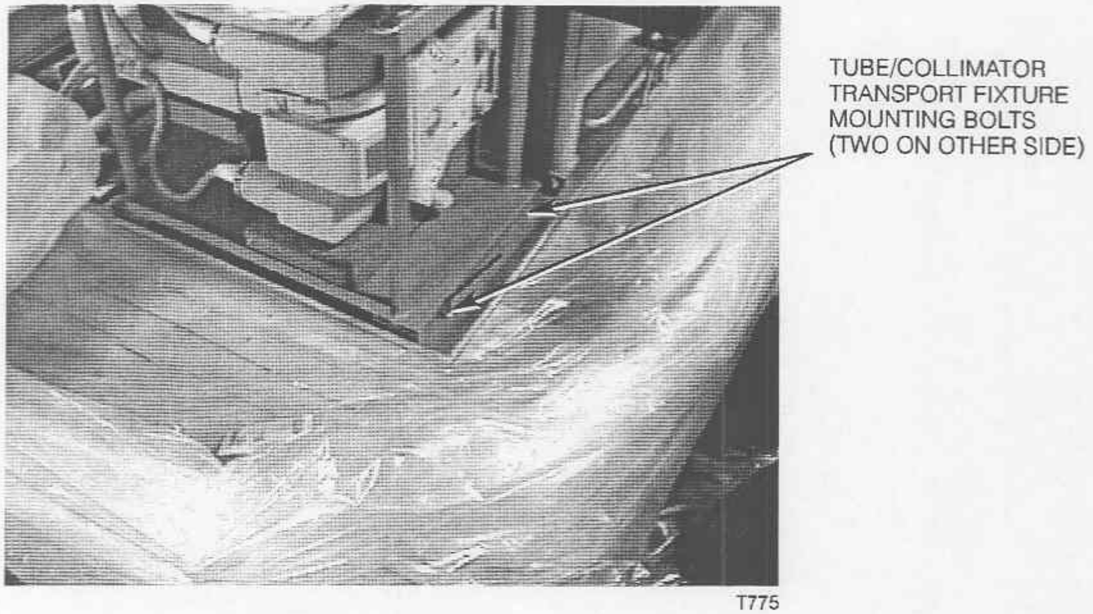

TUBE/COLLIMATOR
TRANSPORT FIXTURE
MOUNTING BOLTS
(TWO ON OTHER SIDE)
T775

FIGURE 2-10 TUBE/COLLIMATOR TRANSPORT FIXTURE MOUNTING

4. Remove the 8 bolts attaching the transverse dolly beams to the baseplate and remove the transverse dolly beams.

SETTING THE SYSTEM UP FOR OPERATION

INTRODUCTION

This procedure is to be used to put the Clinix VP4 into the operational mode after it has been installed or to return it to operation after it has been placed in the transport mode.

SET-UP PROCEDURE

1. Place the foam pad on the table top as shown in **Figure 3-1**. Employing two people, lift the tube/collimator transport fixture onto the head end of the tabletop as shown **Figure 3-1**.

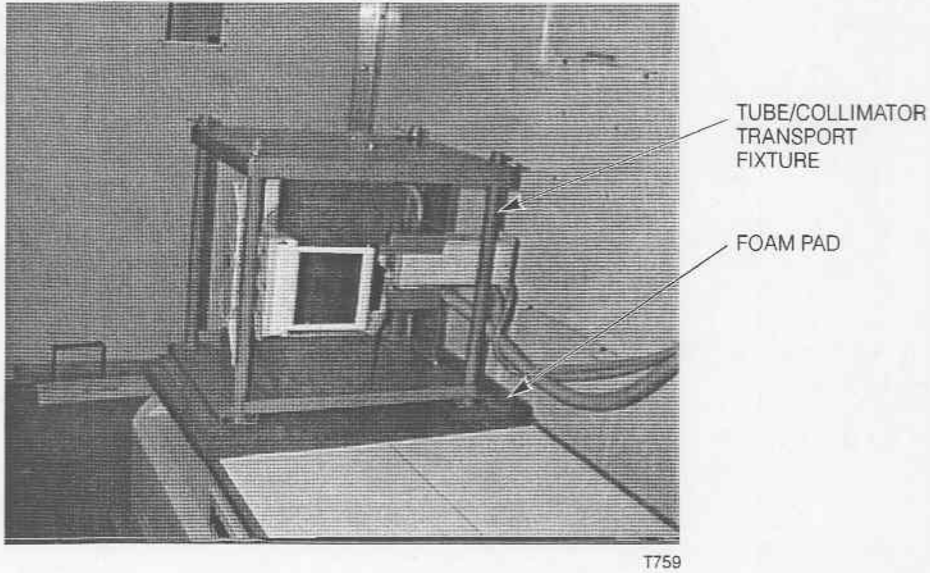


FIGURE 3-1 TUBE/COLLIMATOR ASSEMBLY POSITIONING

2. Remove the two attaching bolts and remove the column hold-down brackets from the column supports as shown in (see **Figure 3-2**). Store the bolts by screwing them back into their holes in the column supports.

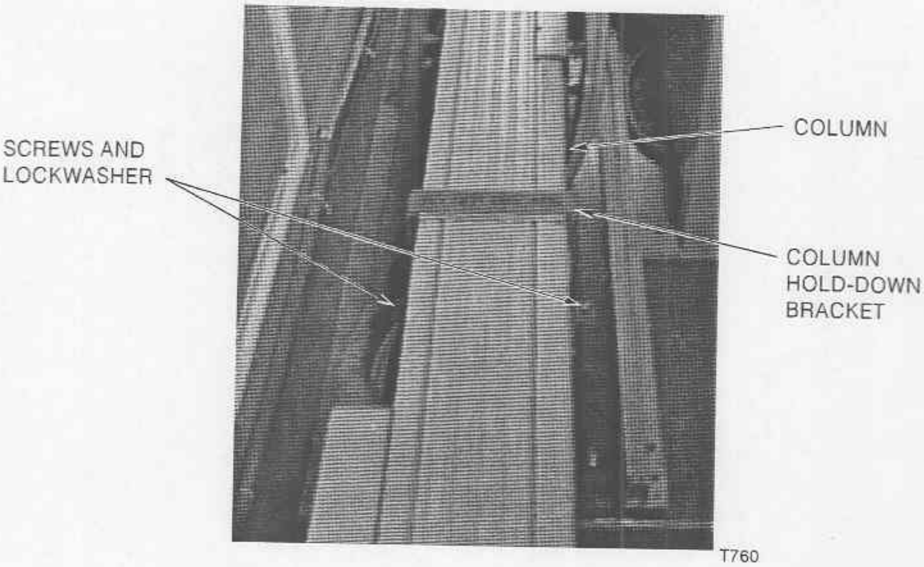

SCREWS AND LOCKWASHER
COLUMN
COLUMN HOLD-DOWN BRACKET
T760

FIGURE 3-2 VERTICAL COLUMN SECURING BRACKET

3. Slide the vertical column toward the foot end as far as it will go. The column hinge should be at the bottom of the column.

4. Raise the tube column to the vertical position as shown in **Figure 3-3**. (The tube column is hinged at the column base.)

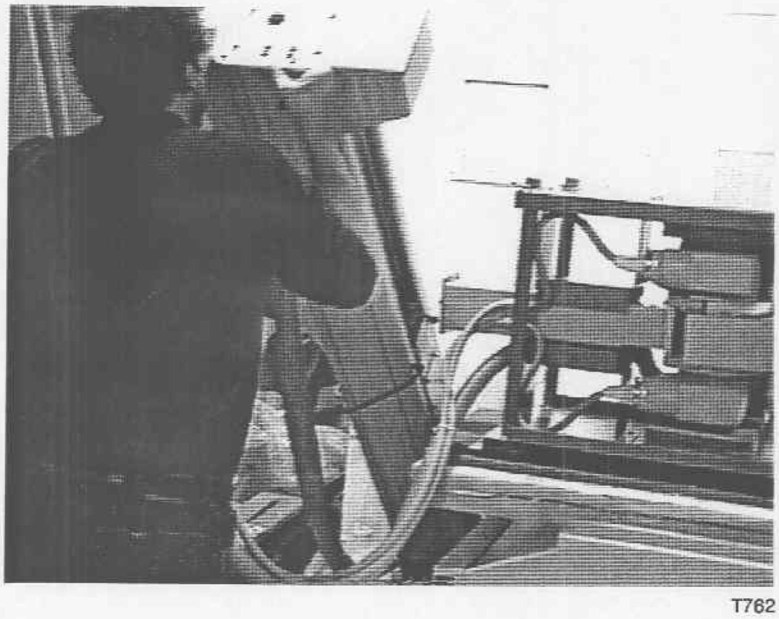


FIGURE 3-3 RIGHTING THE VERTICAL COLUMN

5. While someone supports the column, Install the four bolts to secure the base of the column to the longitudinal carriage as shown in **Figure 3-4**.

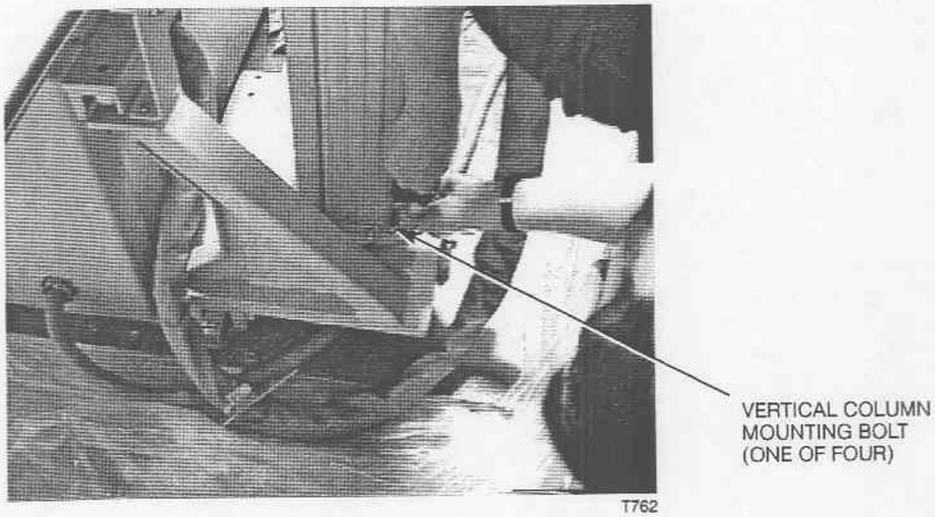

VERTICAL COLUMN
MOUNTING BOLT
(ONE OF FOUR)
T762

FIGURE 3-4 VERTICAL COLUMN MOUNTING

6. Remove the four screws that fasten the column hinge to the longitudinal carriage (see **Figure 3-5**). Loosen the small hinge securing screw indicated in **Figure 3-5**, fold the hinge and secure it with the small screw.

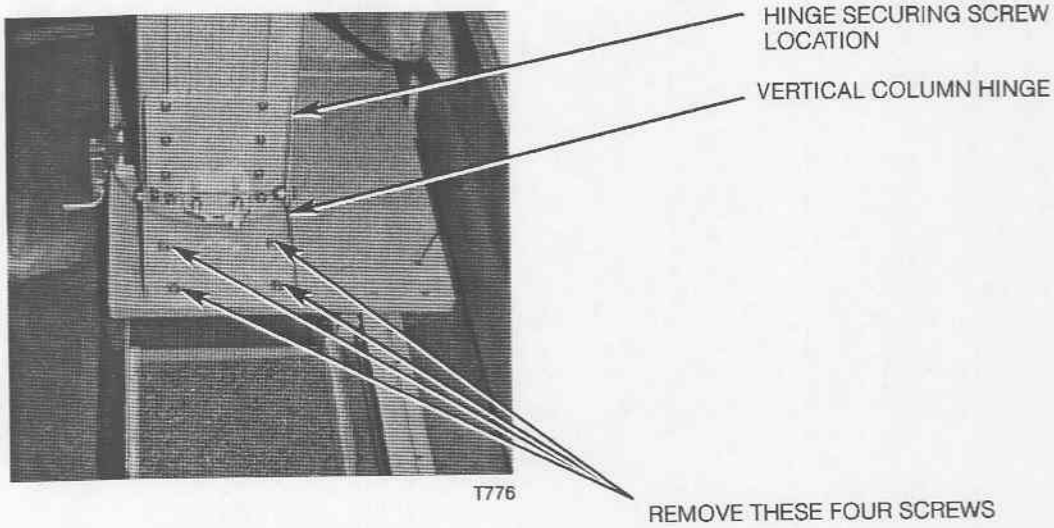

HINGE SECURING SCREW
LOCATION
VERTICAL COLUMN HINGE
T776
REMOVE THESE FOUR SCREWS

FIGURE 3-5 COLUMN HINGE

7. Remove the 8 screws that attach the two column transport supports (shown in **Figure 3-6**) to the baseplate and remove the two column supports. Store the column for use during future transportation of the unit.

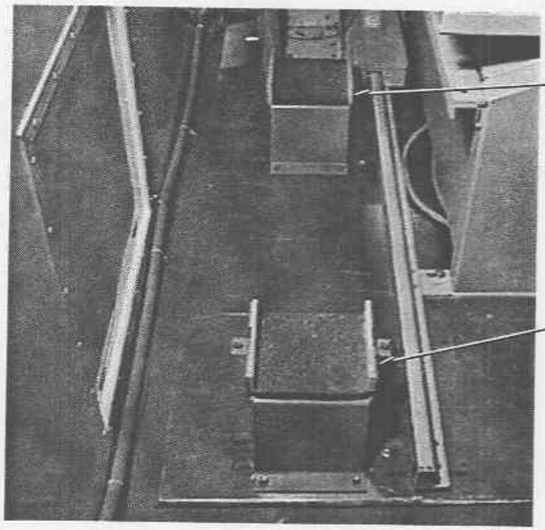

COLUMN SUPPORT BRACKET
COLUMN HOLD-DOWN SUPPORT BRACKET
T777

FIGURE 3-6 COLUMN TRANSPORT SUPPORTS

8. Remove the tubearm mounting bolts from the vertical carriage and remove the vertical carriage shipping bracket shown in **Figure 3-7.** Store the bracket for use during future transportation of the unit.

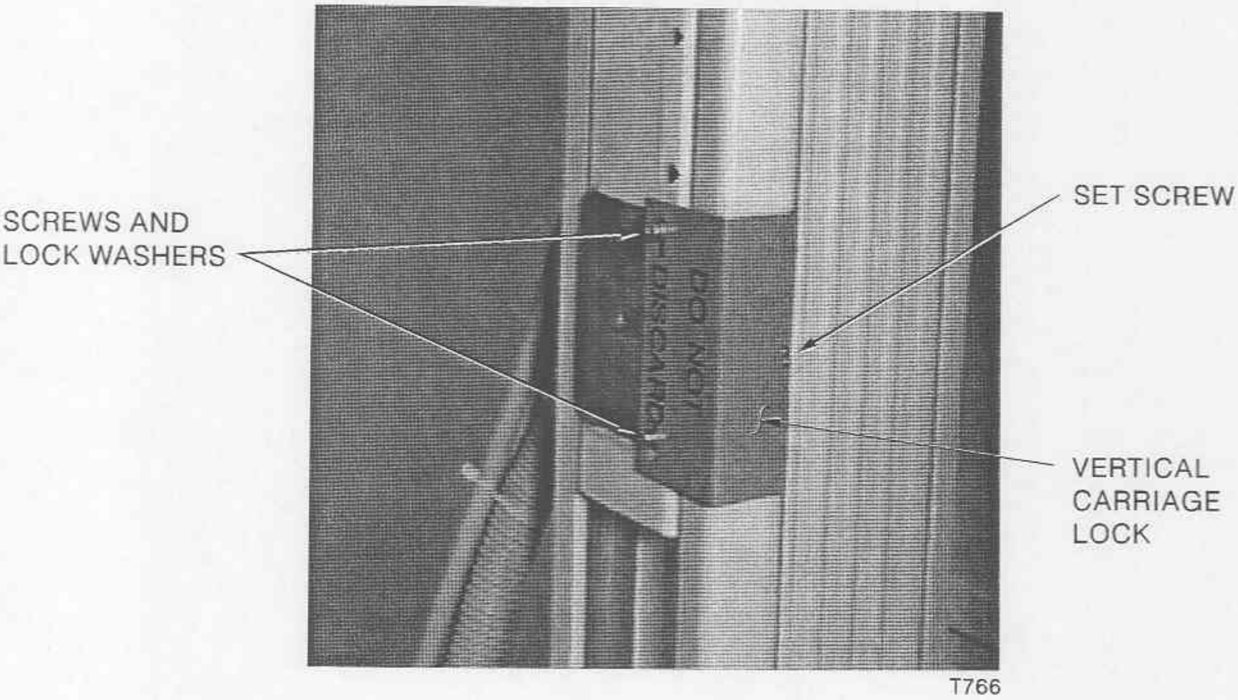

SCREWS AND LOCK WASHERS
DO NOT DISCARD
SET SCREW
VERTICAL CARRIAGE LOCK
T766

FIGURE 3-7 VERTICAL CARRIAGE SHIPPING BRACKET

9. Move the column longitudinally toward the head end so that the transverse tube arm aligns with the vertical carriage as shown in **Figure 3-8**.

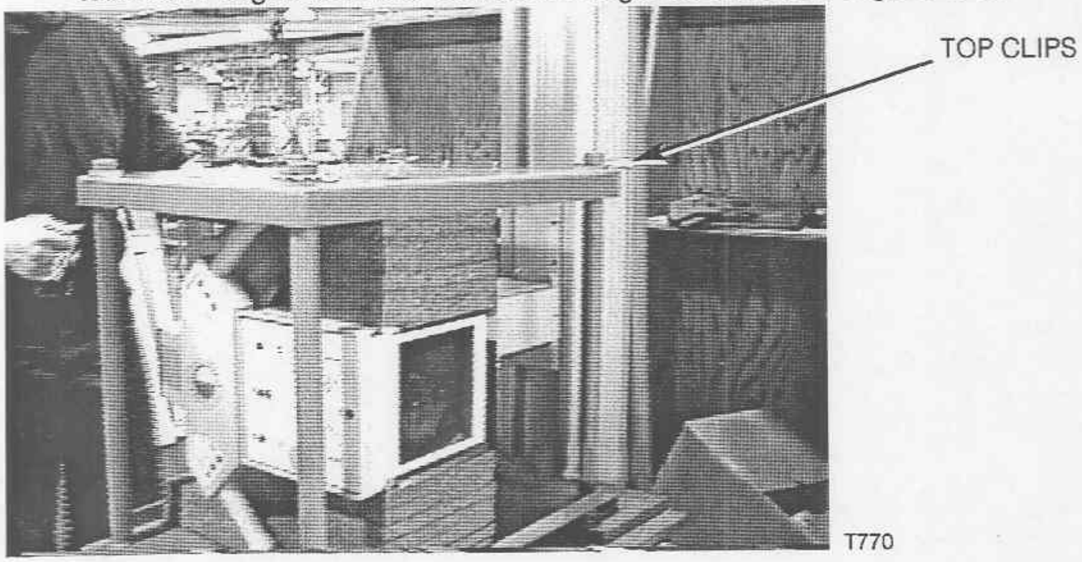


FIGURE 3-8 TUBEARM AND COLUMN POSITIONING

10. Press the top release foot beam on the front of the table to move the top to the rear to mate the tube arm to the vertical column. Attach the transverse tube arm to the vertical carriage with four bolts as shown in **Figure 3-9**.

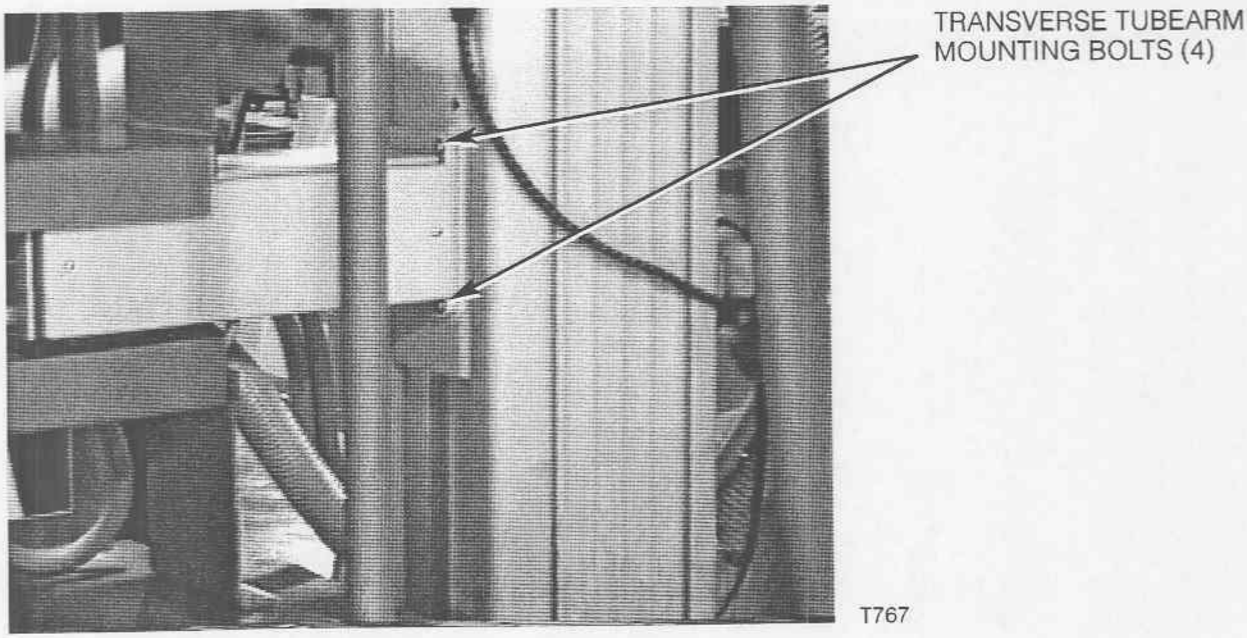


FIGURE 3-9 TRANSVERSE TUBEARM MOUNTING

11. Remove the counterweight support pin from the back of the tube column (see **Figure 3-10**). Turn the pin around and reinstall it in the holding bracket with the long end sticking through the bracket.

12. Remove the clips that hold the top on the tube/collimator transport fixture and remove the top of the fixture (see **Figure 3-9**).

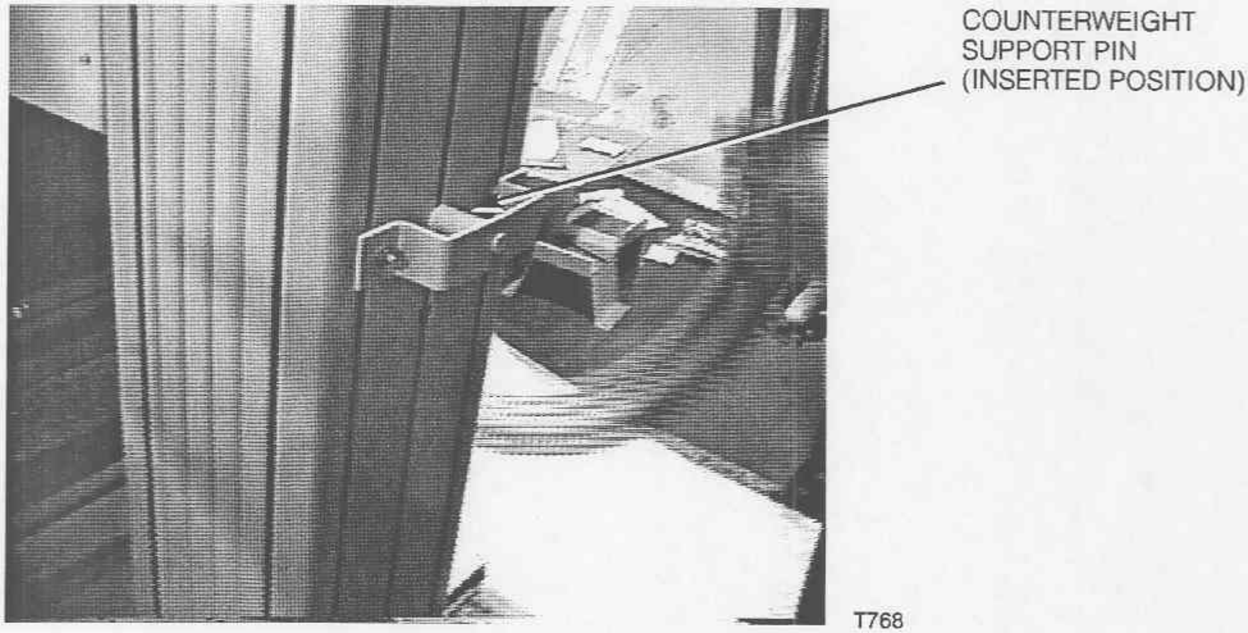


FIGURE 3-10 COUNTERWEIGHT SUPPORT PIN

13. Lift the tubehead assembly vertically out of the tube/collimator transport fixture (this may take considerable lifting force unless power is applied to release the vertical locks).

14. Place the top back on the tube/collimator transport fixture and store it for the next time the shelter is to be transported.

15. Push the excess cable into the hole in the back of the table (see **Figure - 3-11**) and mount the hole cover as shown.

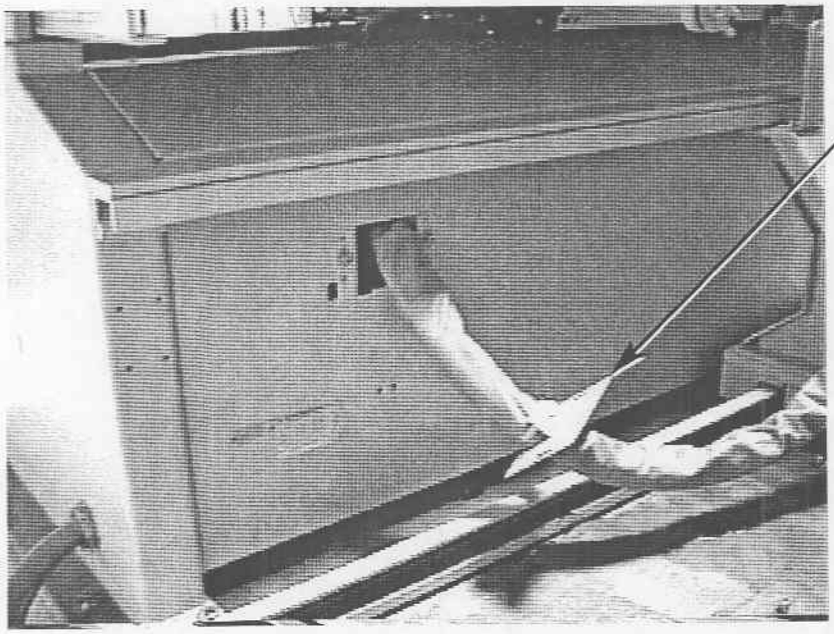

HOLE COVER
T771

FIGURE 3-11 TABLE CABLE COVER

16. Unhook the elastic cord that holds the bucky in position during transport from the table rail (see **Figure 3-12**). The elastic cord is self-storing and should not be removed.

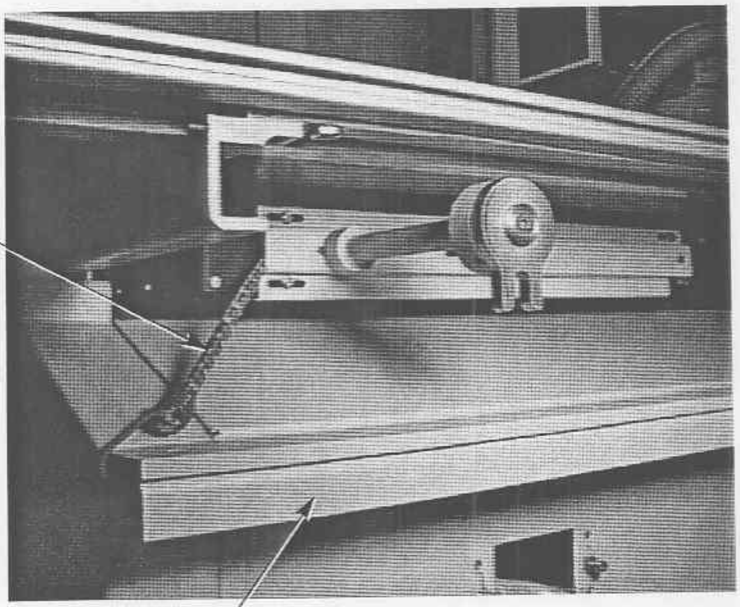

BUCKY RESTRAINT CORD
GUIDE RAIL
T753

FIGURE 3-12 BUCKY SECURING CORD

17. Unlock the cassette tray locking device (shown in **Figure 3-13**) by loosening the thumbscrew, moving the latch all the way to the right and retightening the thumbscrew.

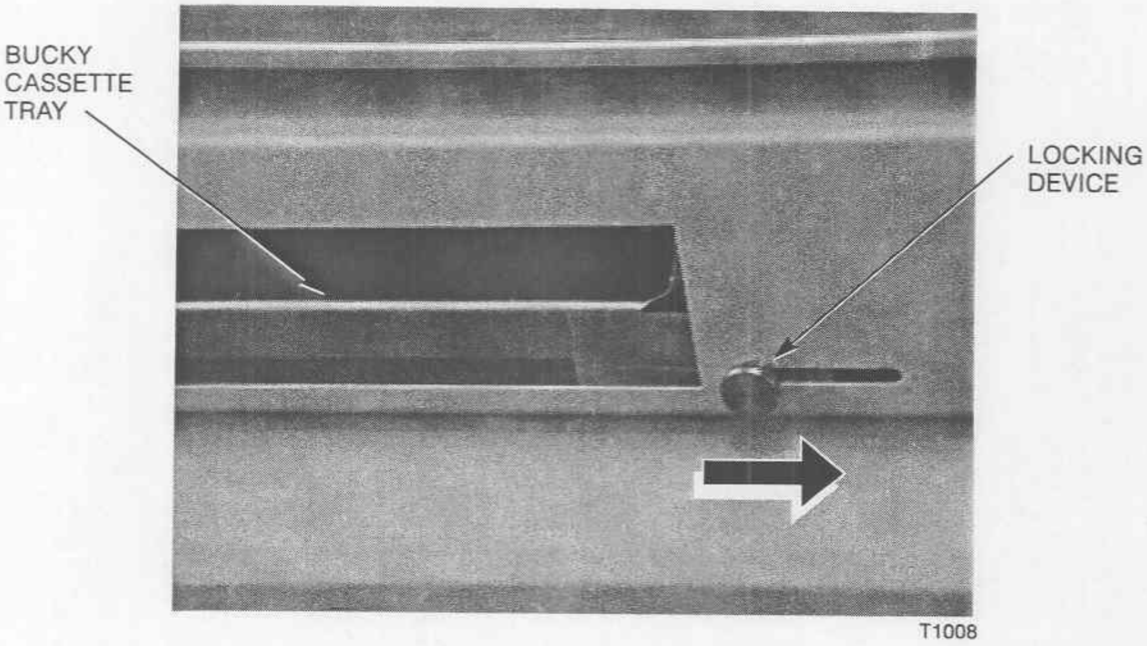

BUCKY CASSETTE TRAY
LOCKING DEVICE
T1008

FIGURE 3-13 CASSETTE TRAY LOCKING DEVICE

SYSTEM CHECK-OUT

Refer to the operator's Guide for the system check-out procedure.

END OF MANUAL

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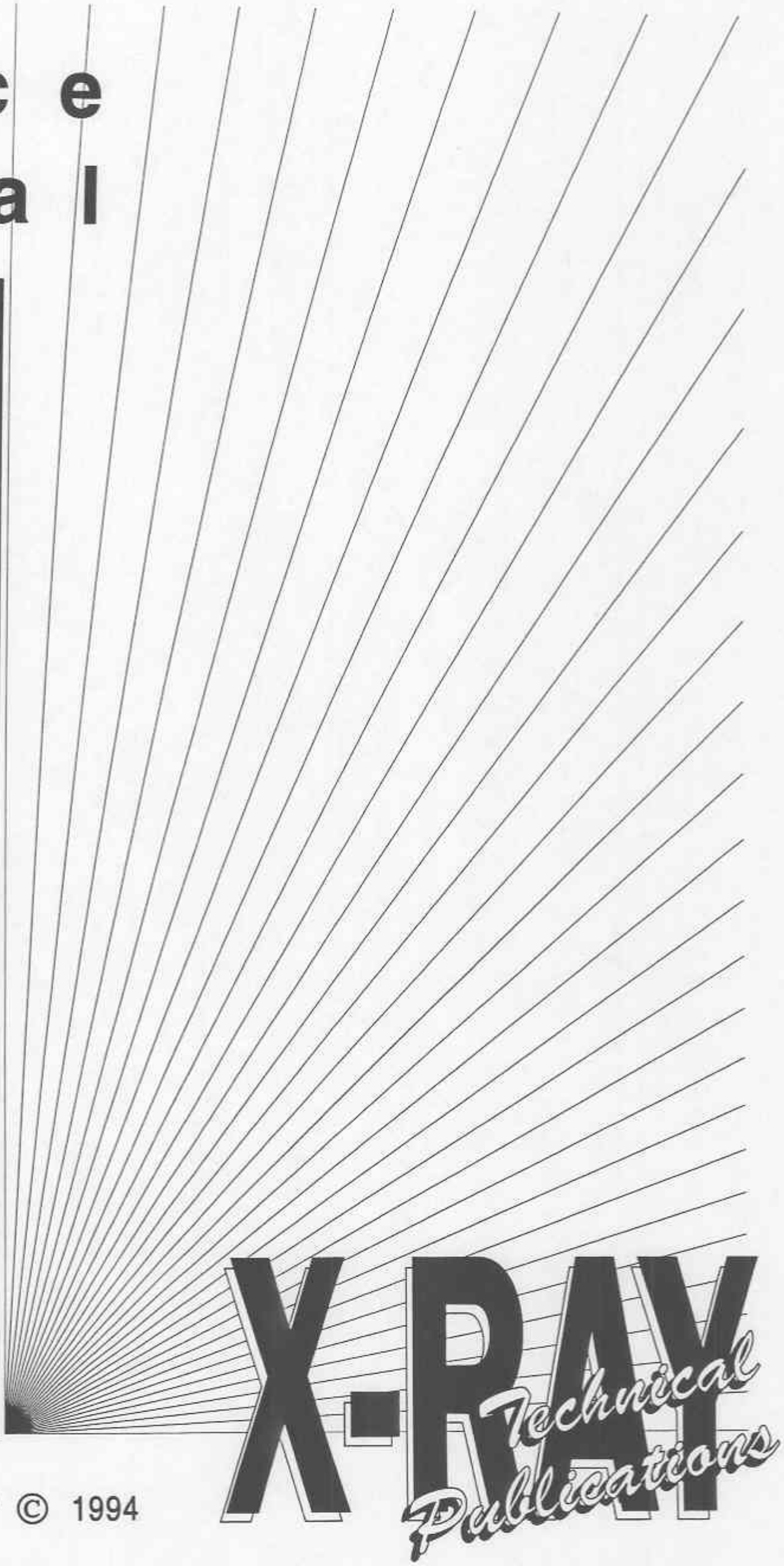

Clinix VP4
X-ray Generator

DRS No.
GX007:S

Part No.
T55E-1072

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Diagnostic X-ray Systems

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DO NOT REMOVE FLEXIBLE HIGH TENSION CABLES FROM X-RAY TUBE HOUSING OR HIGH TENSION GENERATOR AND/OR ACCESS COVERS FROM GENERATOR UNTIL THE MAIN AND AUXILIARY POWER SUPPLIES HAVE BEEN DISCONNECTED.

FAILURE TO COMPLY WITH THE FOREGOING MAY RESULT IN SERIOUS OR FATAL BODILY INJURIES TO THE OPERATOR OR THOSE IN THE AREA.

ELECTRICAL GROUNDING INSTRUCTIONS

THE EQUIPMENT MUST BE GROUNDED TO AN EARTH GROUND BY A SEPARATE CONDUCTOR. THE NEUTRAL SIDE OF THE LINE IS NOT TO BE CONSIDERED THE EARTH GROUND. ON EQUIPMENT PROVIDED WITH A LINE CORD, THE EQUIPMENT MUST BE CONNECTED TO A PROPERLY GROUNDED, THREE-PIN RECEPTACLE. DO NOT USE A THREE-TO-TWO PIN ADAPTER.

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Diagnostic X-ray Systems

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GENERAL DESCRIPTION

INTRODUCTION

The purpose of this manual is to provide service personnel with a basic description of the Clinix VP4 Generator system and clear and complete instructions covering the calibration, maintenance, and troubleshooting of the Clinix VP4 Generator.

This section provides a basic description of the Clinix VP4 Generator system delineating the major components and briefly identifies the function of each component and the interrelations to other components as appropriate. In addition to major components, accessories are also identified and briefly described. This section also contains the physical and electrical specifications of the generator.

DESCRIPTION

The Clinix VP4 Generator is a microprocessor-controlled inverter/x-ray generator with a capacity of 40 kW and is designed for routine radiographic diagnostic applications. The generator is designed to control the solid state pickup included with the Clinix VP4 table and its accessories.

The Clinix VP4 Generator is comprised of four major components and is shown in **Figure 1–1**. The four major components are the control panel, the electronics chassis, the inverter chassis, and the high-tension transformer.

The control panel provides the user with a convenient method of controlling the functions of the Clinix VP4 generator system. All available controls are present on the control panel and are described in detail in the **Clinix VP4 System Operator's Guide, TX008:F**.

The other three major components of the Clinix VP4 generator (the electronics chassis, inverter chassis and high-tension generator), are located inside the Clinix VP4 table and house the electronic equipment necessary for operation of the Clinix VP4 generator. These three components are mounted on casters for service accessibility.

A detailed description of each major component is provided in the following paragraphs.

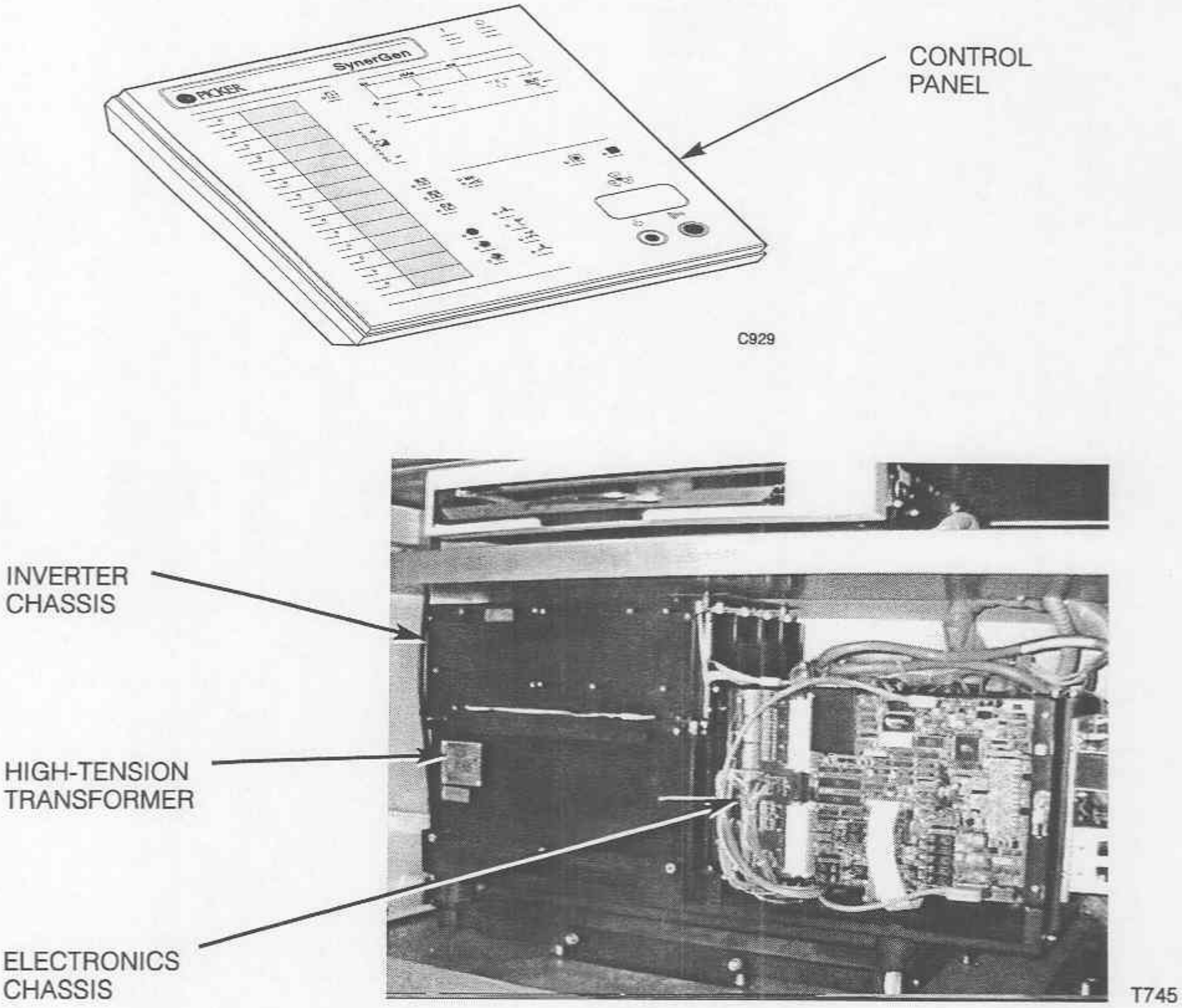
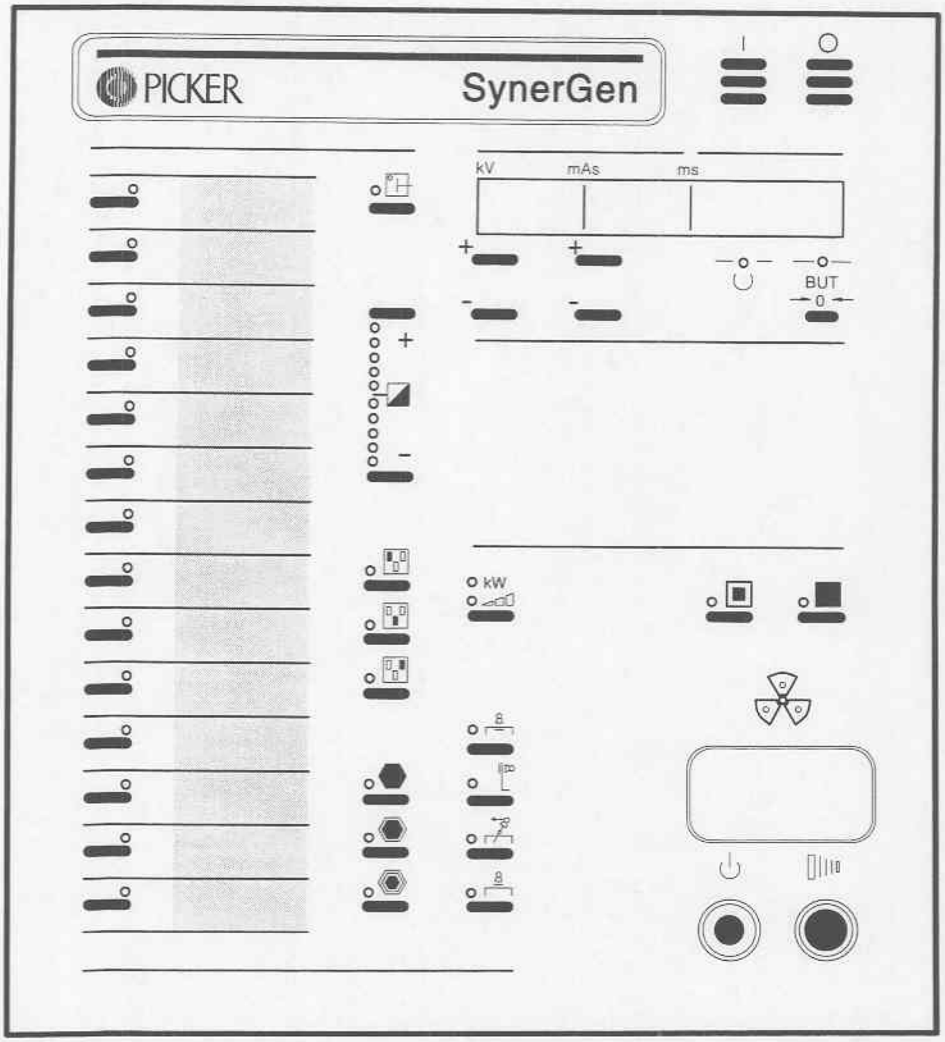

PICKER
SynerGen
CONTROL PANEL
C929
INVERTER CHASSIS
HIGH-TENSION TRANSFORMER
ELECTRONICS CHASSIS
T745

FIGURE 1–1 CLINIX VP4 GENERATOR MAJOR COMPONENTS

CONTROL PANEL

The control panel contains all controls and indicators available to the operator including Anatomically Programmed Radiography (APR). If required, the APR parameters, such as Automatic Exposure Control (AEC), kV, and mAs, may be changed using the controls on the control panel. The control panel showing the location of the controls and indicators is shown in **Figure 1–2**.

The functions of the controls and indicators are described in detail in the **Controls and Indicators** section of the **Clinix VP4 System Operator's Guide**, **TX008:F**.



C1210

FIGURE 1–2 CLINIX VP4 CONTROL PANEL

The control panel is connected to the electronics chassis by way of a standard RS232 interconnecting cable.

ELECTRONICS CHASSIS

The electronics chassis houses all components required for connection to the power line (including fuses) and for generator-to-table connections. It also houses the Power ON/OFF PCB, the +5/±15 Volt Power Supply PCB, the Central Unit (CU) PCB (microprocessor), and the Anode Starter PCB. A view of the electronics chassis and associated components is shown in **Figure 1–3**.

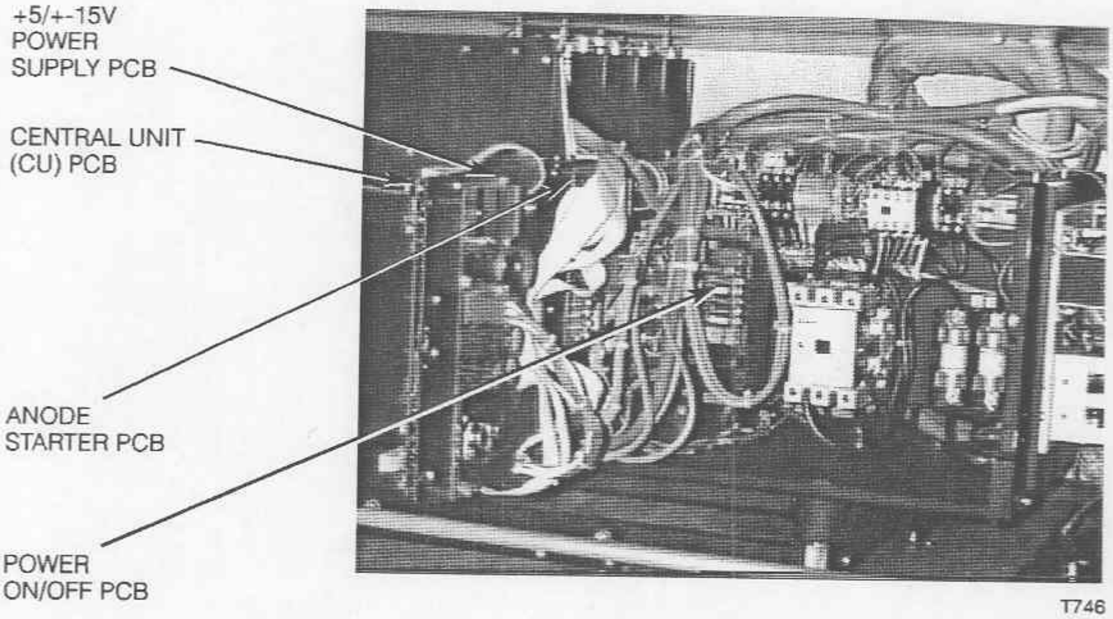


FIGURE 1–3 ELECTRONICS CHASSIS COMPONENTS

INVERTER CHASSIS

The inverter chassis is mounted on top of the high-tension transformer and houses some of the intermediate power circuit components (rectifiers, relays, capacitors, and power resistors), the Impulse Unit (IPU) PCB, the Filament Drive PCB, and the Inverter Control (mA IVC) PCB. The inverter chassis including related components is shown in **Figure 1–4**.

HIGH-TENSION TRANSFORMER

The high-tension transformer (see **Figure 1–1**) houses the silicon rectifiers, the high-voltage capacitors and the filament transformer for the x-ray tubes. It is mounted on castors for easy accessibility and provides mounting for the inverter chassis.

ACCESSORIES

There are three accessories available with the Clinix VP4 x-ray system. These accessories are illustrated and described in the paragraphs that follow.

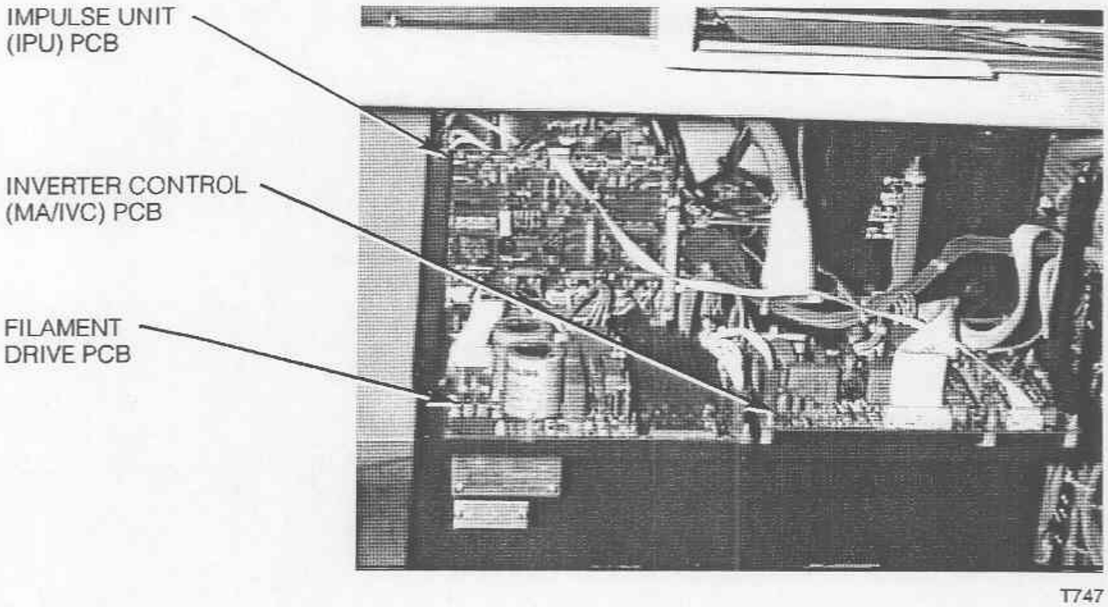

IMPULSE UNIT (IPU) PCB
INVERTER CONTROL (MA/IVC) PCB
FILAMENT DRIVE PCB
T747

FIGURE 1–4 INVERTER CHASSIS COMPONENTS

HAND GRIPS

The hand grips are shown in **Figure 1–5**. These make the patient feel more secure while the tabletop is being moved. The hand grips are inserted into the tabletop accessory rails.

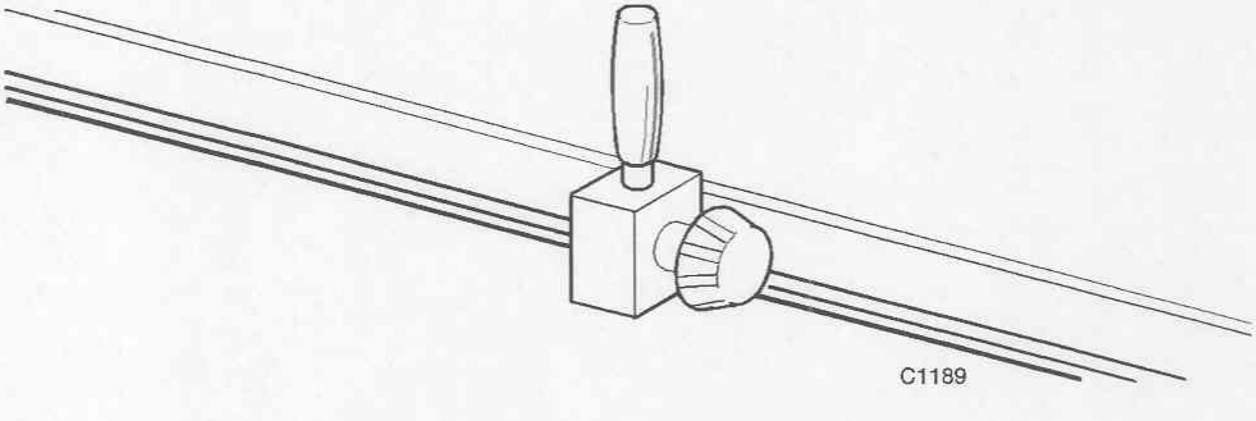


FIGURE 1–5 HAND GRIPS

COMPRESSION DEVICE

The compression device attaches to the tabletop accessory rails and is shown in **Figure 1–6**. The transparent compression band can be used to compress or immobilize the body part under examination. The device is self-locking.

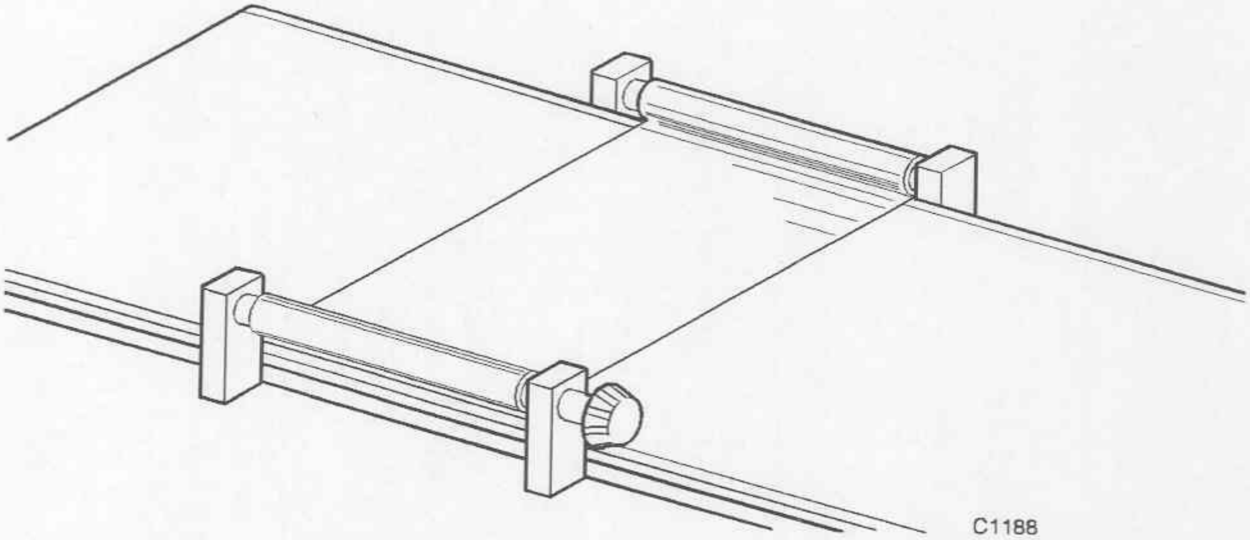


FIGURE 1–6 COMPRESSION DEVICE

LATERAL CASSETTE HOLDER

The lateral cassette holder is used for cross-table radiography as shown in **Figure 1–7**. The lateral cassette holder is inserted into the tabletop accessory rails.

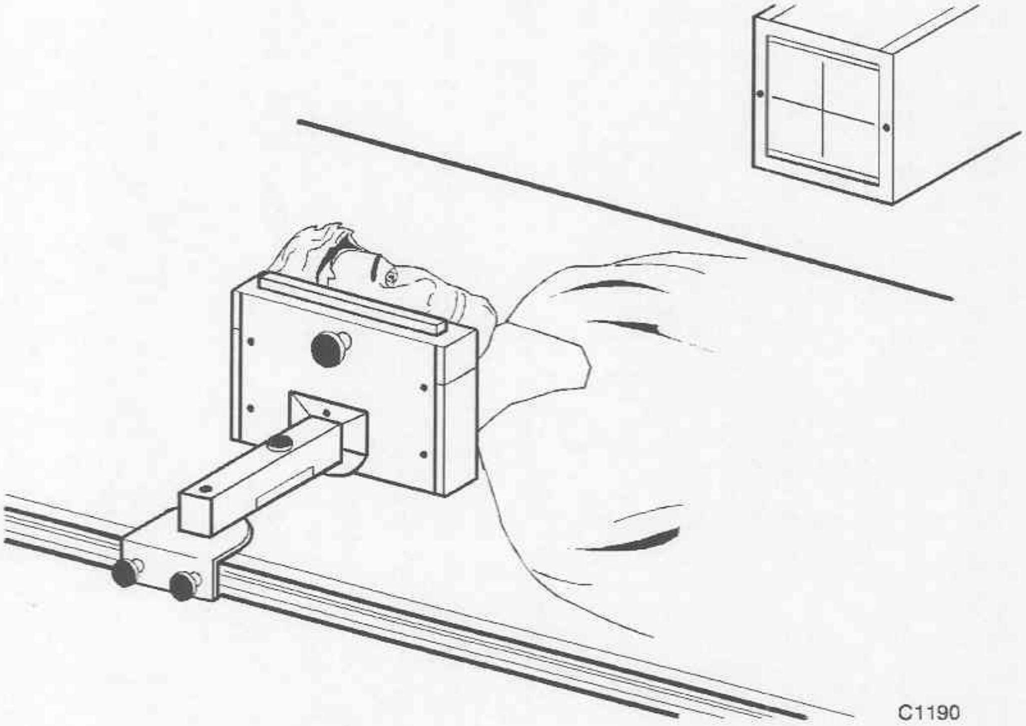


FIGURE 1–7 LATERAL CASSETTE HOLDER

STANDARD FEATURES

The following are included as standard Clinix VP4 Generator features:

- Exposure time as low as 2 ms.
- Low kV ripple.
- Rapid stabilization of kV and mA during exposures.
- Significant operational data of the generator system are constantly monitored by special control programs. Deviations, such as changes in the x-ray tube cathode, are automatically corrected resulting in long-term stability of exposure factors.
- X-ray tube overload protection.
- Line voltage fluctuations during exposures are automatically compensated.
- Errors are automatically stored in an error log upon occurrence.
- Control panel for easy operation.
- Automatic Exposure Control (AEC) system.
- Anatomically Programmed Radiography (APR) including the following:
  - A temporary change of exposure factors is easily and conveniently accomplished by using manual override operation.
  - 56 APR programs are available with four different examination units. The corresponding programs can be individually changed by the user.
  - Microprocessor-controlled automatic exposure control (AEC) system.
  - Programmed exposure technique can be used with or without AEC.

OPERATING LIMITS

TABLE

Tabletop Travel from Center Position

Transverse travel:	± 127 mm
Longitudinal travel:	± 470 mm

BUCKY UNIT

Travel:	560 mm
Tabletop-film distance:	71 mm

Film center to table end distance

Head end:	300 mm (minimum)
Foot end:	400 mm (minimum)

TUBE COLUMN

Focal spot vertical travel:	253 – 1775 mm (horizontal beam)
X-ray tube swivel:	+30° and -20° (within trunnions)
Vertical range, support arm:	164 cm
Longitudinal travel, tube column:	128 cm

Rotation of x-ray tube unit about vertical

Column axis:	± 90°
Detents at:	± 90°

Rotation of x-ray tube unit about horizontal

Support arm axis:	± 90°
Detents at:	± 90°

PHYSICAL CHARACTERISTICS

CONTROL PANEL

Height:	39.50 in. (1003.3 mm)
Length:	14.50 in. (368.3 mm)
Width:	13.00 in. (330.2 mm)
Mass:	11.0 lbs. (5 kg)

ELECTRONICS CHASSIS

Height:	79.50 in. (2019.3 mm)
Length:	19.25 in. (488.9 mm)
Width:	22.00 in. (558.8 mm)
Mass:	209.4 lbs. (95 kg)

HEAT EMISSION

Generator and x-ray tube:	330 W

ELECTRICAL CHARACTERISTICS

POWER

40 kW Output

OUTPUT

62 kV @ 640 mA	80 kV @ 500 mA
100 kV @ 400 mA	125 kV @ 320 mA

KV-RANGE

40 kV - 125 kV in steps of 1 kV

TUBE CURRENT

50 mA - 640 mA

EXPOSURE TIME

2 ms (with and without AEC)

EXPOSURE INCREMENTS

2.0 mAs - 320 mAs, ±5% in 24 steps

ACCURACY/TOLERANCES

kV	± 4 kV
mAs	± 5% (2.0 - 320 mAs)

OVERLOAD PROTECTION

Provided for each exposure as a function of permissible tube loading.

STABILIZATION DURING EXPOSURE

Rapid-response kV and mA regulation.

HIGH-TENSION TECHNOLOGY

Inverter technology with regulated inverter; extremely rapid response to line-voltage and high-voltage fluctuations.

POWER LINE CONNECTIONS

Line voltage	208 - 240 VAC, three-phase

NOMINAL LINE DEMAND

Short times	66 kVA
No load	120 VA

LINE FUSE

60 A slow blow

POWER RATING

40 kVA

NAMEPLATE DATA

Equipment model numbers, serial numbers, and related data are provided on unit nameplate(s). For location of nameplates, refer to **Figures 1–8** and **1–9**.

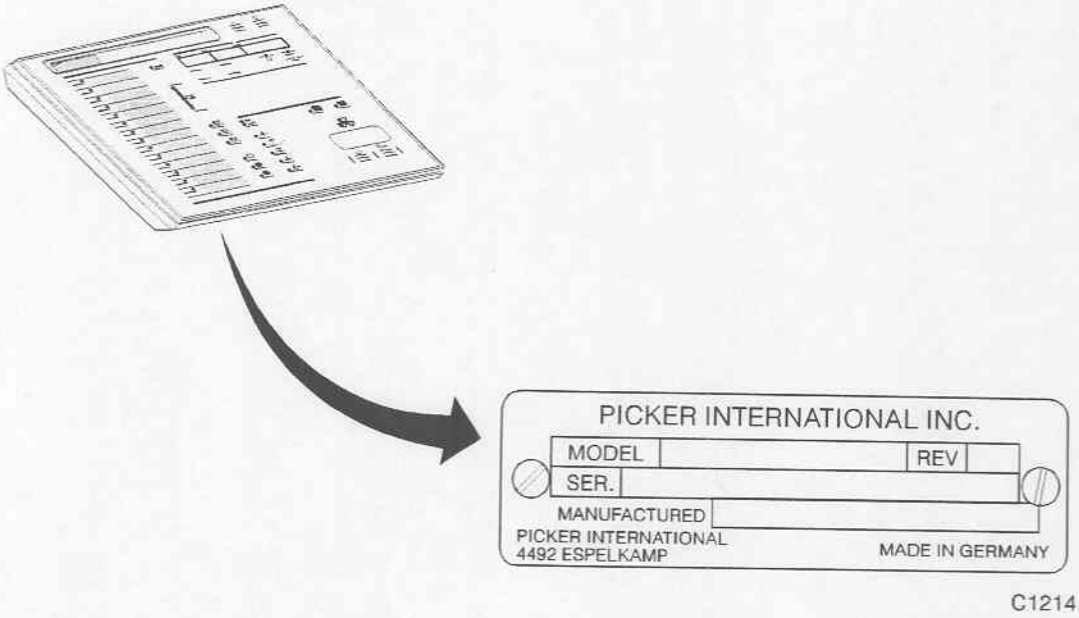

PICKER INTERNATIONAL INC.
MODEL
REV
SER.
MANUFACTURED
PICKER INTERNATIONAL
4492 ESPELKAMP
MADE IN GERMANY
C1214

FIGURE 1–8   CONTROL PANEL NAMEPLATE

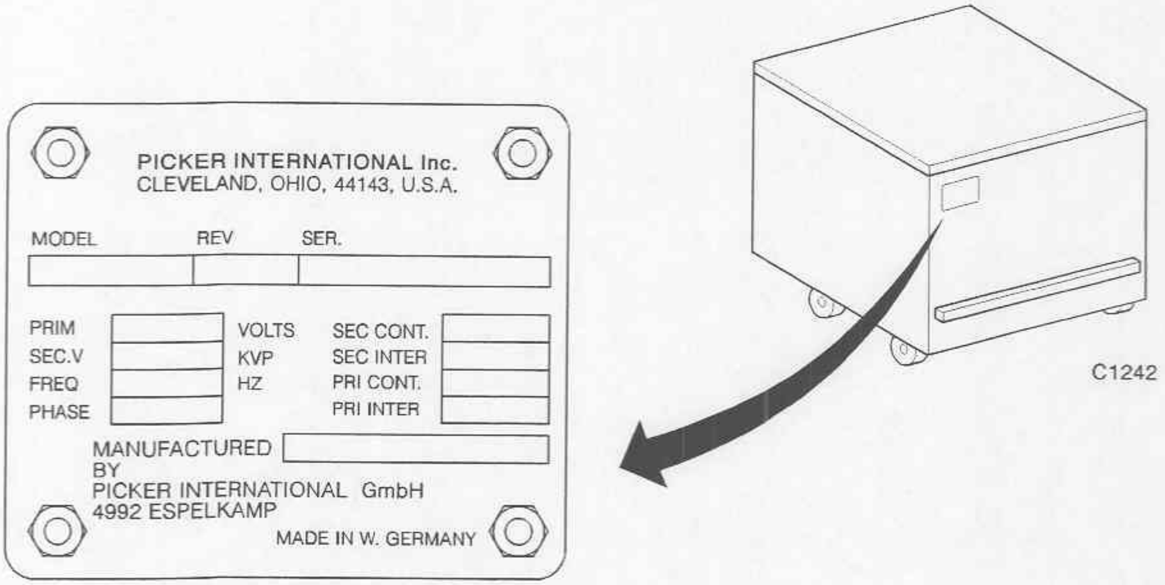

PICKER INTERNATIONAL Inc.
CLEVELAND, OHIO, 44143, U.S.A.
MODEL
REV
SER.
PRIM
SEC.V
FREQ
PHASE
VOLTS
KVP
HZ
SEC CONT.
SEC INTER
PRI CONT.
PRI INTER
MANUFACTURED
BY
PICKER INTERNATIONAL GmbH
4992 ESPELKAMP
MADE IN W. GERMANY
C1242

FIGURE 1–9 HIGH-TENSION GENERATOR NAMEPLATE

THEORY OF OPERATION

INTRODUCTION

The purpose of this section is to provide a detailed theory of operation of the Clinix VP4 Generator System. The Clinix VP4 Generator is a micro-processor controlled inverter/x-ray generator with a capacity of 40 kW. The Clinix VP4 Generator is designed for all routine radiographic diagnostic applications.

CLINIX VP4 GENERATOR SYSTEM OVERVIEW

An overview of the function of the Clinix VP4 Generator is shown in block diagram form in **Figure 2–1**.

The simplified block diagram shown in **Figure 2–1** depicts the major components of the Clinix VP4 generator system and their relationship with each other. A detailed description of each individual component is provided in the paragraphs that follow.

FUNCTIONAL DESCRIPTIONS

POWER CIRCUIT

The power circuit supplying the Clinix VP4 generator system consists of four major functional groups:

1. Line connection
2. Intermediate Circuit
3. Power On/Off PCB
4. +5/±15V Power Supply PCB

The power circuit provides the connection to the room power. It also is responsible for distributing power to all other components of the system. A discussion of each of the four major power circuit functional groups is provided in the paragraphs that follow.

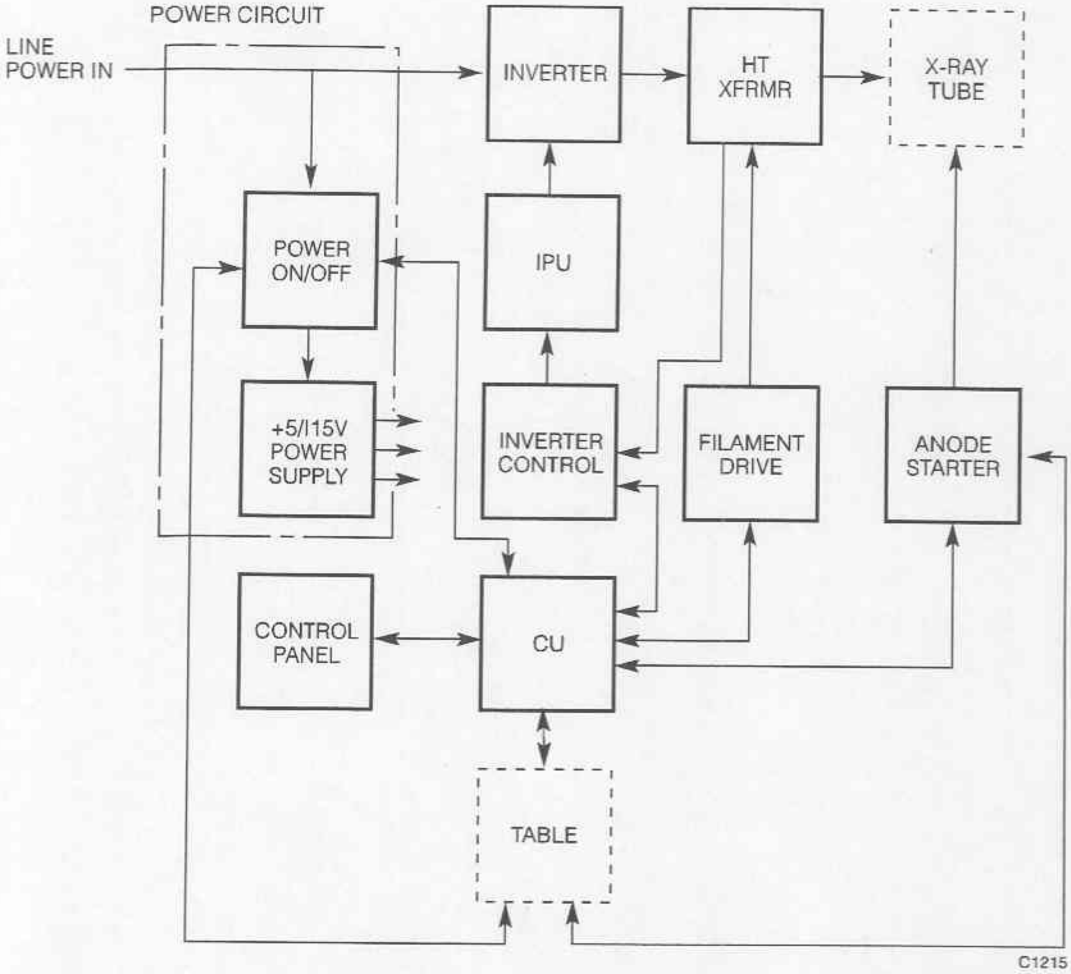

POWER CIRCUIT
LINE
POWER IN
INVERTER
HT
XFRMR
X-RAY
TUBE
POWER
ON/OFF
IPU
+5/I15V
POWER
SUPPLY
INVERTER
CONTROL
FILAMENT
DRIVE
ANODE
STARTER
CONTROL
PANEL
CU
TABLE
C1215

FIGURE 2–1 CLINIX VP4 GENERATOR BLOCK DIAGRAM

Line Connection

For discussion of **Line Connection**, refer to Schematic Package Power Circuit schematic diagram 1181-S12. The line supply leads are connected to fuses F01 through F03. From these fuses, the line voltage is directed to two separate places: the high voltage line contactors K01 and K02, and the low voltage supply transformer T01.

When power is applied to the generator, the capacitors in the intermediate segment of the power circuit are charged up through K01 and the resistors R01 and R02. The resistors serve to limit the charging current, as the capacitors in their discharged state represent a short circuit across the line.

Intermediate Circuit

The first stage of the intermediate circuit is formed by the power diodes CR01 through CR03 configured as a bridge rectifier. These power diodes are connected to the filter capacitors C01A through C01H. The maximum intermediate circuit voltage is 700 volts, therefore, the eight filter capacitors are connected in a series–parallel configuration: two groups of four parallel capacitors connected in series.

Power On/Off PCB

The Power On/Off PCB (schematic diagram 1174-23-S1) receives power from the secondary connections of the supply transformer T01 and are connected by the plug connector P1 to the Power On/Off PCB, and distributed and equipped with safety fuses. The fuse assignments are listed in **Table 2–1**.

TABLE 2–1 POWER ON/OFF PCB FUSE ASSIGNMENTS

Fuse	Value	Description
F1	110 Vac	General ac Usage
F2	55 Vac	Filament Drive PCB
F3	132 Vac	General ac Usage
F4	23 Vac	Bridge Rectifier Input Voltage Regulator (24 Vac)
F5	19 Vac	±15 Vdc Power Supply (positive)
F6	19 Vac	±15 Vdc Power Supply (negative)
F7	24 Vdc	From Output Voltage Regulator (general)
F8	24 Vdc	Regulated, Supply For Control Panel
F9	24 Vdc	To Central Unit 5 Vdc Regulator, unregulated

Relays K2 and K3 are controlled in parallel by inverter IC U24G located in the OUT-RAD section of the CU. A logic LOW output at U24G energizes both K2 and K3.

When the coil of relay K2 is energized, regulated 24Vdc is supplied through fuse F7 and contact K2-B and 55Vac is supplied to the filament drive PCB through fuse F2 and contact K2-C.

When the coil of relay K3 is energized, 110Vac is supplied through fuse F1 and contacts K3-B and K3-C. A jumper from TB1B to TB1C determines 110Vac through K3-C.

The voltage regulator U3 is adjusted to 24Vdc by potentiometers R7 and R8 and supplies the control panel. The regulator is designed for 3A maximum.

When power is applied to the control panel, the current supply for the control panel flows from voltage regulator U13 through fuse F8 and the current detector, consisting of CR6, CR11, CR12 and CR13. The control panel supply current causes a voltage drop of approximately 2.5V across the current detector diodes which causes optocoupler U2 to conduct.

This voltage drop is only achieved if at least 25 mA flows through the diodes. The input, pin 3 of U1C, and the output, pin 13 of U1D, are at a logic level LOW (indicated by CR17 illuminating). The LOW logic signal at U1D pin 13 energizes relay K1 which energizes the 5V power supply through fuse F9 (contact K1D), +15V through fuse F5 (contact K1B), and -15V through fuse F6 (contact K1C). This logic LOW signal is also applied to the EPC section of the Central Unit and is used to determine the readiness of system power and to allow computer power to remain ON after the system has been turned OFF to enable the CPU to finish processing active program segments.

+5/±15V Power Supply PCB

The **+5/±15V Power Supply** PCB (schematic diagram 1174-22-S1) receives unregulated 24 Vdc from the **Power ON/OFF** PCB and filters and regulates the incoming voltage to +5Vdc for the Central Unit PCB.

The **+5/±15V Power Supply** PCB also receives two sources of 19Vac from the **Power ON/OFF** PCB and regulates, filters, and rectifies these voltages to the ±15Vdc supplies required by the CU PCB and all remaining system PCBs.

It supplies the Central Unit PCB directly by way of connector J6. All other PCBs are supplied either indirectly through the CU PCB or by way of the **+5/±15V Power Supply** PCB connector J5. The dc supply voltages are provided with status indication on the **+5/±15V Power Supply** PCB by means of an LED for each voltage. The relationship between the supply voltages and the corresponding LEDs is shown in **Table 2–3**.

TABLE 2–2 +5/±15V PCB LED INDICATORS

Supply Voltage	LED Indicator
+5 Vdc	CR31
-15 Vdc	CR44
+15 Vdc	CR41

The +15 and -15Vdc supplies are independently adjustable with potentiometers R53 and R54, respectively. The +5Vdc supply is not adjustable.

CENTRAL UNIT

The Clinix VP4 Generator central unit is comprised of eight functional parts and is shown in simplified block diagram form in **Figure 2–2**. Refer to Schematic Package schematic number 1174-21-S1 Bl 1 for this discussion.

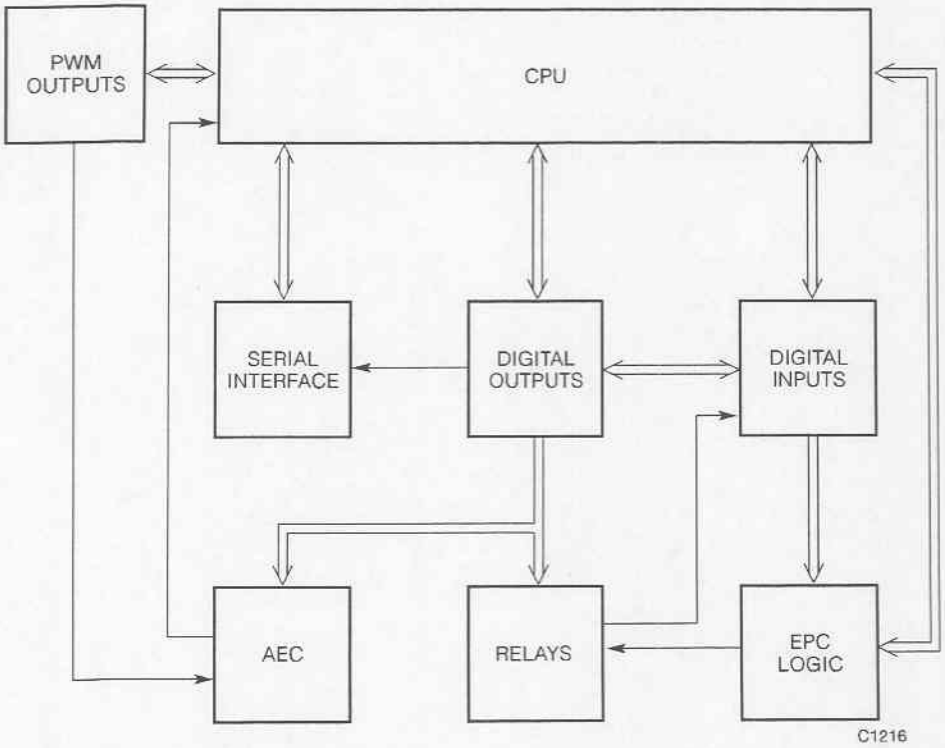

PWM OUTPUTS
CPU
SERIAL INTERFACE
DIGITAL OUTPUTS
DIGITAL INPUTS
AEC
RELAYS
EPC LOGIC
C1216

FIGURE 2–2 CENTRAL UNIT SIMPLIFIED BLOCK DIAGRAM

The CU receives power from the power circuit by way of the **+5/±15V Power Supply** PCB connector J6. The voltages received are: regulated 24Vdc, and regulated voltages +5, +15, and -15Vdc.

All supply voltages on the CU PCB are provided with status indication by means of an LED. The relationship between the supply voltages and the corresponding LEDs is shown in **Table 2–3**.

The CU PCB provides supply voltages to other system PCBs by way of connectors J31 and J70. It also supplies +24Vdc to the control panel by way of connector J4.

TABLE 2–3 CU SUPPLY VOLTAGE LED INDICATORS

Supply Voltage	LED Indicator
+24 Vdc	CR31
+5 Vdc	CR32
-15 Vdc	CR33
+15 Vdc	CR34

The central unit is the main controlling unit of the Clinix VP4 generator system. It interfaces with nearly all of the remaining components of the system. Each of the eight functional parts are described individually in detail in the paragraphs that follow.

Processor

Unless otherwise specified, for theory discussion of the **Processor**, refer to Schematic Package schematic diagram 1174-21-S1 Bl 2.

The processor of the Clinix VP4 Generator system is defined as a CPU and the supporting hardware necessary to enable its operation. The processor consists of the following functional groups each of which is defined in the following paragraphs:

- CPU SAB80C517A
- Low byte address/data demultiplexer
- Memory and address decoding
- I/O address decoding
- 5 V power fail and reset logic
- 15 V power fail logic
- Timer 82C54

CPU SAB80C517A

The CPU is based on an enhanced 8-bit processor which is clocked by the 16 Mhz quartz crystal Y1 at pins 40 and 39 (XTAL1 and XTAL2). The CPU is reset by a LOW signal on pin 10 (/RESET) after power is applied, and begins execution of the program stored in memory. The /RESET signal must be present for at least 2 clock cycles of the internal oscillator to take effect. The reset output signal /RO on pin 82 provides a synchronized /RESET signal (logic LOW) to the interconnected peripherals. This signal can be set with a hardware reset (at pin 10), a watchdog-timer reset, or a oscillator-watchdog reset.

Pin 51 (/EA) is tied LOW to indicate to the processor that all program commands are to be obtained from an externally connected program memory. Pin 60 (/HWPD) is tied HIGH to prevent external hardware power-downs. Pins 52 through 59 (port P0) and pins 41 through 48 (port P2) provide the 16-bit address and 8-bit data connections for the externally connected program/data memory and I/O expansions. Pin 49 (/PSEN) is used to control access to the program and data memory. When /PSEN is LOW program memory is accessed. When /PSEN is HIGH data memory and I/O expansion is accessed.

Pins 27 and 28 (/WR and /RD) are used to control the read/write functions of data memory and I/O expansions. A LOW on either of these lines (/WRE or /RD) enables the write or read function of data memory and the I/O expansions respectively.

Pin 69 (OWE) determines the function of the oscillator watchdogs. Jumper JP26 allows hardware setting of this function. JP26 jumper settings are defined in **Table 2–4**.

TABLE 2–4 JP26 JUMPER SETTINGS FOR OWE SIGNAL

Jumper JP26		Function
From	**To**	
Pin 1	Pin 2	Enables oscillator watchdog
Pin 2	Pin 3	Disables oscillator watchdog

Power-savings mode and watchdog timer usage is defined by jumper JP27 which determines the logic status of CPU pin 4 (/PE/SWD). JP27 jumper settings are defined in **Table 2–5**.

TABLE 2–5 JP27 JUMPER SETTINGS FOR /PE SWE SIGNAL

Jumper JP27		Function
From	**To**	
Pin 1	Pin 2	Disables power savings mode
Pin 2	Pin 3	Enables power savings mode

NOTE

> The watchdog-timer is disabled after a reset and can only be enabled by software.

Low Byte Address/Data Demultiplexer

The address lines A0 through A7 (AD0 through AD7 at CPU pins 52 through 59) are buffered through IC U9 when CPU pin 50 (/ALE) is a logic level HIGH.

The output of U9, addresses A0 through A7, are combined with CPU address lines A8 through A15 (pins 41 through 48) to generate the 16-bit address bus A0 through A15.

Memory and Address Decoding

For theory discussion of **Memory and Address Decoding**, refer to Schematic Package schematic diagram 1174-21-S1 Bl 3.

The address decoding for the memory components and the I/O-expansions is accomplished with programmable address decoder IC U8. Address lines A7 through A15, together with the control signals /PSEN, /RD, /WR, /RESET and ENABLE_R are used to generate the required chip select signals to select between program memory (IC U7) and NVRAM (IC U6).

The default program memory configuration is 32K x 8 with a maximum available of 64K x 8. Jumpers JP3, JP4, JP5 and JP7 are used to determine the program memory configuration (size). Setting a program memory configuration is accomplished using jumper settings defined in **Table 2–6**.

TABLE 2–6 PRORAM MEMORY CONFIGURATION JUMPERS

Program Memory	**JP3**		**JP4**		**JP5**		**JP7**	
	From	To	From	To	From	To	From	To
32k x 8	N/A	N/A	Pin 1	Pin 2	Pin 1	Pin 2	Pin 2	Pin 3
64k x 8	Pin 3	Pin 4						

The default data (NVRAM) memory configuration is 8K x 8 with a maximum available of 32K x 8. Jumpers JP13 and JP6 are used to determine the data memory configuration (size). Setting a data memory configuration is accomplished using jumper settings defined in **Table 2–7**.

TABLE 2–7 NVRAM MEMORY CONFIGURATION JUMPERS

Data (NVRAM) Memory	JP13		JP6	
	From	To	From	To
8k x 8	Pin 1	Pin 2	Pin 1	Pin 2
32k x 8	Pin 2	Pin 3	Pin 1	Pin 2

Data RAM Control

IC U12 is used to control access to the data memory (NVRAM) and to expand the data memory to a size greater than 32k x 8. IC U10 is used to monitor the status of the data memory (NVRAM) control signals.

The software controlled signals BD0 through BD3 (pins 2,3,4 and 5 of IC U10) are used to expand the NVRAM data range up to 512K x 8.

The software controlled signal ENABLE_R (pin 9 of U10) is used to protect the upper half of the data range from access. This signal is evaluated accordingly in the address decoder IC U8 pin 23.

The signals /CEDATA and /WR_RAM (pins 7 and 6 of IC U10) are optionally used to provide software controlled protection of the NVRAM.

Jumpers JP1 and JP2 determine the access options to the NVRAM. Jumper JP1 determines whether the signal /CSRAM (pins 1 and 2 jumpered) or the OR'ed combination (IC U1B) of /CSRAM and /CEDATA (pins 2 and 3 jumpered) provide the LOW logic signal required to enable the NVRAM memory IC at pin 22 (/CE).

Jumper JP2 determines whether the signal /WR (pins 1 and 2 jumpered) or the OR'ed combination (IC U1A) of /WR and /WR_RAM (pins 2 and 3 jumpered) provide the LOW logic signal (/WRDATA) required to enable the write enable (/WE) function of the NVRAM memory IC at pin 29.

Address Decoding

Access to the program memory (IC U7) is provided directly by the CPU signal /PSEN through the address range 0000H to FFFFH. Address decoding is provided in **Table 2–8**.

TABLE 2–8 MEMORY ADDRESS DECODING

Designation	Signal Name	Address
CS U6 NOVA RAM 8K x 8	/CSRAM	0000H ... 1FFFH
CS U12 data RAM control write	WR_DB	F100H
CS U10 data RAM control read	/RD_DB	180H
CS U31 timer 82C54	/CSTIMER	F200H .. F203H
CS I/O Expansion	/CSIO	F500H .. F5FFH

The internal address range of the 256 x 8 on-chip data RAM of the CPU is 00H through FFH. The internal address range of the 2K x 8 on-chip XRAM of the CPU is F800H through FFFFH.

I/O Address Decoding

For discussion of **I/O Address Decoding**, refer to Schematic Package schematic number 1174-21-S1 Bl 2.

The I/O expansions are responded to with the signal /CSIO in the address range F500H through F5FF. The I/O address decoding is provided in **Table 2–9**.

TABLE 2–9 I/O ADDRESS DECODING

Selected I/O Component	Signal Name	Address
U25 82C55	/EW1	F500H ... F503H
U26 82C55	/EW2	F508H ... F50BH
MOD1 OPTO IN MODULE	/EW3	F510H
MOD2 OPTO IN MODULE	/EW4	F518H
MOD3 OPTO IN MODULE	/EW5	F520H
Not used	/EW6	F528H
Not used	/EW7	F530H
Not used	/EW8	F538H

The binary decoder/demultiplexer IC U3 decodes the expansion chip select signals (/EW1 through /EW8) with the signal /CSIO and the address connections A3, A4, A5 and A6.

5V Power-Fail and Reset Logic Circuit

IC U30 generates a reset signal (/RESET) at pin 5 and sends it to CPU pin 10 (/RESET) when the +5Vdc supply voltage is applied. During operation, IC U30 monitors the +5Vdc supply voltage. If the +5Vdc supply voltage drops below the value of +4.7Vdc, the /RESET_POWER signal is regenerated.

NOTE

> A targeted reset may be triggered by an external source by temporarily shorting the pins of jumper JP14.

The /RESET signal from pin 5 of IC U30 and the /RO signal from pin 82 of the CPU are applied to the diode pair CR98 and CR99. These diodes are configured as an OR logic gate. The output of this pseudo-OR gate is applied to inverters and the signals /RESET (active LOW) and RESET (active HIGH) are generated at pins 6 and 10, respectively, of IC U16. These two signals are used to reset peripheral components.

±15V Power Fail Logic

IC U29 monitors the ±15Vdc supply voltages of the analog circuits. If either of the two voltages (or both simultaneously) drops below the set reference level, the signal /POWERFAIL_15 (active_LOW) is generated and is applied to pin 24 of the CPU (P3.3).

The reference level for the -15Vdc supply voltage is determined by the voltage divider network consisting of resistors R30 and R66. The reference level for the +15Vdc supply voltage is determined by the voltage divider network consisting of resistors R32 and R65. Both voltage divider networks have resistor selected to maintain reference voltage levels at -14 and +14Vdc, respectively.

Timer

Timer IC U31 generates the 3 different time bases, ET0, ET1 and ET2, that are required to control internal processes in the CPU. The frequency of these time bases is configurable with software.

The operating base frequency (signal /CSTIMER) of 1.333 MHz is received at pins 9, 15 and 18 of IC U31 from CPU pin 30 (P1.6).

The signal ET0 is applied to CPU pin (P1.0). Signal ET0 supplies a frequency of between 100 and 500 Hz corresponding to 10 and 2 ms as trigger for the mA measurement.

The signal ET1 is applied to CPU pin 25 (P3.4) and may be optionally connected to CPU pin 26 (P3.5) with pins 2 and 3 of jumper JP17 connected. Signal ET1 supplies a frequency of 10 kHz for the CPU internal safety and delay timer.

Alternately, signal ET2 may be optionally connected to CPU pin 26 (P3.5) with pins 1 and 2 of jumper JP17 connected. Signal ET2, however, is not used in the Clinix VP4 Generator system.

Digital Inputs

For discussion of **Digital Inputs**, refer to Schematic Package schematic number 1174-21-S1 Bl 4.

All digital inputs applied to the Central Unit from an external source are connected through optocouplers.

Input signals for the EPC logic and signals that are connected directly to the CPU inputs are routed through the SMD optomodule MOD7, and are buffered for signal adaptation with IC U21.

All remaining input signals received from the CPU, are routed through the SMD optomodules MOD1, MOD2 and MOD3. The CPU controls which module is selected by signal lines EW3, EW4, and EW5. Any one of these three signals OR'd with the /RD signal makes the corresponding module active by a logic LOW signal at pin 33 (/CS) of the module.

mA Actual Value Frequency

The mA actual value frequency (0 to 100 kHz) from the external IVC measuring circuit PCB is connected to the Central Unit by way of pin 1 of the 26 pin ribbon connector J50. This signal (signal /MA_ACT) is applied directly through optocoupler IC U20 to pin 29 of the CPU (P1.7) and processed there.

Jumper JP8 provides a means of choosing the source of the +24Vdc supply voltage to IC U20. The source choices are the Central Unit or the mA IVC PCB. **Table 2–10** provides a summary of the jumper settings for JP8.

TABLE 2–10 JP8 JUMPER SETTINGS

Jumper JP8		Function
From	To	
Pin 1	Pin 2	IC U20 supply from mA/IVC PCB
Pin 2	Pin 3	IC U20 supply from CU PCB

Digital Outputs

For discussion of **Digital Outputs**, refer to Schematic Package schematic number 1174-21-S1 Bl 5.

All digital outputs required by the output expansion ICs U25 and U26 to control relays, or that are derived from the central unit, are routed through the open-collector driver ICs U19, U23, U24, U27, and U28.

LED CR79 is controlled by the signal /CPU_ACTIVE (pin 16 of IC U28). This signal is cyclically activated by the software so that the LED blinks to indicate that the CPU is functioning.

Serial Interfaces

For discussion of **Serial Interfaces**, refer to Schematic Package schematic number 1174-21-S1 Bl 6.

There are two serial interface ports provided in the Clinix VP4 generator system. Both ports (J2 and J1) are standard RS232 type serial interface ports. The port at connector J2 (serial interface 1) can be configured as an RS485 type, however, this type interface is not used in the Clinix VP4 generator system. The two ports are controlled by the CPU signals (U33, 1174-21-S1 Bl 2) as defined in **Table 2–11**.

The levels of the signals provided by the CPU are converted to RS232 levels by IC U35 (1174-21-S1 Bl 6).

Serial interface 1 (J2) is used as the primary serial interface and is used by the Central Unit to communicate with the control panel.

TABLE 2–11 SERIAL INTERFACE SIGNAL DEFINITIONS

Signal		CPU U33	
Nomenclature	Name	Pin	Name
Send Interface 1	TxD0	22	P3.1
Receive Interface 1	RxD0	21	P3.0
Send Interface 2	TxD1	72	T6.2
Receive Interface 2	RxD1	71	T6.1

In addition to the standard RS232 signals on serial interface 1, +24Vdc is supplied to the control panel (+24V_POWER_ON) on pin 9 of connector J2. This +24Vdc supply comes from the **Power ON/OFF PCB** by way of connector J4.

The second serial interface, serial interface 2, is normally not used but is available for future expansion peripherals. This connection is available through connector J1. Only the standard RS232 type interface is present at this port.

The standard configuration of jumpers pertaining to serial interfaces is defined in **Table 2–12**.

TABLE 2–12 SERIAL INTERFACE JUMPER SETTINGS

JP21		**JP22**		**JP24**			
From	To	From	To	From	To	From	To
Pin 1	Pin 2	Pin 1	Pin 2	Pin 1	Pin 2	Pin 3	Pin 4

PWM Outputs

For discussion of **PWM Outputs**, refer to Schematic Package schematic number 1174-21-S1 Bl 7.

The PWM signals (PWM0 through PWM7) are received from the CPU through port P4 for the generation of analog nominal-value signals. These signals are applied to inverter power driver ICs U13 and U16.

The PWM signals are isolated by a series resistance and protected by diodes.

Jumpers JP34 and JP30 may be used to optionally apply analog-ground reference to the receiving electronics.

EPC Logic

For discussion of **EPC Logic**, refer to Schematic Package schematic number 1174-21-S1 Bl 8.

The EPC logic monitors the x-ray exposure control. If an error is detected, the error signals /K53_0N and /FAILURE_STOP are forced to a logic level LOW. These signals terminate the exposure. The signal /K53_ON energizes relay K53 when LOW.

When the signal /FAILURE_STOP goes LOW, a logic network consisting of ICs U14, U17 and U18 inhibit the /INV_START signal.. Also, the CPU receives a simultaneous interrupt at pin 32 (P1.4) and begins processing the error.

The signals listed in **Table 2–13** will cause an error to be detected in EPC logic and will activate signals /K53_0N and /FAILURE_STOP with simultaneous indication to the CPU.

TABLE 2–13 ERRORS DETECTED BY EPC LOGIC

Signal Name	CPU Pin	CPU Name
/KV_OVER	64	P5.4
/MA_ERROR_CATHODE	65	P5.3
/MA_ERROR_ANODE	66	P5.2
/FILA_OVER	68	P5.0
/MA_ERROR	67	P5.1
/KV_WD_TIMEOUT	63	P5.5

The signal /MA_ERROR is activated if the signal /MA_EXIST is detected without CPU exposure release, that is, in the presence of spurious tube current. This error is released by the CPU pin 76, port P6.6 (/MA_ERROR_ENABLE).

kV Watchdog

The signal /KV_WD_TIMEOUT is activated if the CPU has issued the exposure release with the signal /MP_EXP_START at pin 35 (P1.1) and the kV watchdog IC U11A has detected an error.

The kV watchdog is inverted at IC U15 and applied to the input of IC U11A. The trigger time of IC U11A is set to approximately 220 mS by the RC network of R12 and C14.

If the CPU trigger signal /KV_WD from pin 77 (P6.7) is missing during an exposure release by /MP_EXP_START, an error message is issued after the trigger time lapses.

Inverter Logic

The signal /INV_GATE_ENABLE_out (exposure preparation) for the inverter control is activated by the signal /INV_GATE_ENABLE received from CPU pin 75 (P6.5) through two inverter gates (ICs U14 and U15). This signal also is combined with the signals /MP_EXP_START, /FAILURE_STOP, /AEC_STOP and /CONSOLE_ON_24V to cause the signal /INV_START to start the inverters. These signals are processed through a logic network consisting of ICs U14, U15, U17 and U18.

The signal /INV_START_TEST which is a result of a portion of this logic, is applied to CPU pin 33 (P1.3) as a status indication.

The signal /CONSOLE_ON_24V provides a safety block. When the control panel is turned OFF, the inverter logic is inhibited. The signal /CONSOLE_ON_24V is received by EPC logic, processed and applied to the CPU pin 61 (P5.7) as signal /CONSOLE_ON. The signal /CONSOLE_ON provides the CPU with a status report of the condition of the control panel.

If the automatic exposure control is selected at the control panel, the signal /INV_START is set high by the signal /AEC_STOP through the logic of ICs U14, U17 and U18. The signal /AEC_STOP is LOW when the measured exposure reaches the calibration nominal exposure value (refer to AEC theory). This condition is also communicated to the CPU by way of the /INV_START_TEST signal at pin 33 (P1.3).

The EPC logic has several status LEDs. The LED and corresponding states are provides in **Table 2–14**.

TABLE 2–14 EPC LOGIC STATUS LEDS

LED On	Signal Name	Status
CR17	/INV_GATE_ENABLE_out	Active
CR18	/INV_START	Active
CR19	/FAILURE_STOP	Active
CR20	/MP_EXP_START	Active

Relays

For discussion of **Relays** theory, refer to Schematic Package schematic number 1174-21-S1 Bl 9.

Technique Selection Relays

The signals required for technique selection are received from the digital outputs section of the Central Unit (CU). When the signal /TABLE is a logic level LOW, relay K360 is energized. When the signal /WALL is a logic level LOW, relay K361 is energized.

The operation of technique selection relays is summarized in **Table 2–15**.

TABLE 2–15 TECHNIQUE SELECTION RELAY OPERATION

Signal	LED	Relay	Section	Description
/TABLE	CR29	K360	1C	Supplies 110Vac to terminal block TB81-27
			2D*	Supplies 110Vac to terminal block TB81-26
			3A	Supplies bucky feedback signal from terminal block TB81-66 as signal /BUCKY_CONTACT_IN
			4B	Supplies 24Vdc GND to terminal block TB81-55
/WALL	CR15	K361	1C	Supplies 110Vac to terminal block TB81-33
			2D*	Supplies 110Vac to terminal block TB81-32
			3A	Supplies bucky feedback signal from terminal block TB81-35 as signal /BUCKY_CONTACT_IN
			4B	Supplies 24Vdc GND to terminal block TB81-56

* – Active only if signal /BUCKY_START signal is LOW; K323 energized.

If 49 kV is selected at the control panel, relay K314 is energized by the signal /ABOVE_49kV and section 1A shorts pins JD82G and JB82G (50 kV filter).

Bucky Relays

The signal /BUCKY_START is received from the digital outputs section of the Central Unit and energizes relay K323. Relay K323 in conjuction with one of the two technique select relays (K360 and K361) provides 110Vac to the terminal block TB81 (refer to **Technique Selection Relays**).

This signal also energizes main relay K02 (located in the relay chassis) through sections 2B and 3C if safety relay K53 is not energized (K53 section 2B closed).

The bucky feedback provided by the currently active technique select relay, is supplied as the signal /BUCKY_CONTACT_IN to the digital input section (1174-21-S1, Bl 4) of the Central Unit. In this section it is processed and supplied to the CPU.

Safety Relay K53

If an error is detected by EPC logic, signal /K53_on is supplied to the relay section. Relay K53 is energized by this signal and a safety shutdown is performed by de-energizing main relay K02 (K53 section 2B).

Excessive filament current detected in the Filament Drive PCB and excessive mA current detected in the mA IVC PCB can also cause K53 to energize with LOW signals at diodes CR42, CR43, and CR44.

Relay K53 is configured as a self-latching relay using section 1A. The self-latching mode is reset only after generator power is removed and re-applied.

AEC Unit

The AEC (Automatic Exposure Control) consists of four functional units, each of which is described individually in the paragraphs that follow.

AEC Input Circuit

For discussion of **AEC Input Circuit** theory, refer to Schematic Package schematic number 1174-21-S1 Bl 10.

The negative pickup signals are routed to the AEC unit through the 15 pin D-shell connector J43. A pickup with an integrated signal may be connected over the central field (WALL jumper JP37, TABLE jumper JP36) and routed to the AEC integrator over the input IPS (Integrator Pickup signal). This integrated pickup signal is not used on the Clinix VP4 system.

One of three possible fields (left, center, or right) are selectable with relays K5, K4 and K3, respectively. Relay K5 activates the left pickup field, relay K4 activates the central pickup field, and relay K3 activates the right pickup field.

The AEC signal received from one of the three possible fields (left, center or right) is applied to the input of operational amplifier IC U42 which is configured as an input amplifier. An offset adjustment is available with potentiometer R98. Relay K2 is used to reduce the amplification of operational amplifier IC U42 when a multiplier pickup is used.

The output of IC U42 is applied to the AEC Integrator section of the AEC Unit through one of two potentiometer/relay combinations, R105/K10 or R106/K9. Potentiometer R105 adjusts the signals of the WALL pickup, and potentiometer R106 adjusts the signals of the TABLE pickup.

AEC Integrator

For discussion of **AEC Integrator** theory, refer to Schematic Package schematic number 1174-21-S1 Bl 11.

This section of the AEC Unit receives four signals from the AEC Input section. The incoming signal INTEGRATOR_IN (pickup signal) is applied to pin 2 of IC U46 which is configured as an integrator. The feedback of this operational amplifier is applied through IC relays U47A and U47B. The control of these relays is supplied by the /AEC_START signal.

The signal IPS is applied to one of two places. It is either terminated to ground through capacitor C56 or applied to the output of operational amplifier IC U43A through resistor R108. The application of this signal is controlled by the relay K11 section 1B. The contacts of K11 can be used to adjust either the AEC integration signal or the IPS signal. The IPS signal is terminated to ground in the Clinix VP4 system.

When signal /AEC_START is logic level HIGH, the integrated signal of INTEGRATOR_IN is applied to IC U44. IC U44 provides a dark current compensation during integration.

IC U43A inverts the received signal (INTEGRATOR_IN). IC U43B functions as a comparator and activates the transistor Q1 to generate the signal /AEC_STOP when the integration signal has reached the switching threshold of the nominal value AEC_NOMINAL (PWM/Analog Conversion).

The signal /AEC_STOP is applied to an input of the EPC Logic and is used to terminate the currently active exposure. At the same time, a report is issued to the CPU U33 port P5.6 (circuit diagram 1174-21-S1, page 2).

The signal /AEC_START releases the integration of the CPU U33 with port P5.6 (circuit diagram 1174-21-S1 page 2).

AEC PWM/Analog Conversion

For discussion of **AEC PWM/Analog Conversion** theory, refer to Schematic Package schematic number 1174-21-S1 Bl 12.

The pulse-width modulated 5Vdc signal AEC_DENSITY is received from the processor and is converted into an analog signal by IC U40 which is configured as a low-pass active filter.

The AEC_NOMINAL value is adjusted through the feedback potentiometer R123 of IC U41. Potentiometers R158 and R83 are used for offset adjustment.

AEC Relay Control

For discussion of **AEC Relay Control** theory, refer to Schematic Package schematic number 1174-21-S1 Bl 13.

The signals for the selection of the pickups for the different operational techniques and the pickup field selection are driven by the Digital Outputs section of the Central Unit PCB which are controlled directly by the processor.

The incoming signals to the AEC Relay Control section of the Central Unit, the relays affected, and the associated LED indicators are summarized in **Table 2–16**.

When energized, section 1A of relays K72, K73 and K74 supply a 24V ground path at terminal block locations TB81-42, TB81-41 and TB81-40, respectively.

TABLE 2–16 AEC RELAY SECTION INCOMING SIGNALS

Signal Name	Relay	LED Indicator
/TABLE	K9	CR88
/WALL	K10	CR86
/AEC_LEFT	K5	CR80
	K72	CR5
/AEC_CENTER	K4	CR82
	K73	CR7
/AEC_RIGHT	K3	CR84
	K74	CR9
/MULTIPLIER	K2	CR74

Central Unit Signal Descriptions

This paragraph provides tabular listings of all of the signal names associated with the Central Unit. The listings are logically grouped in three separate tables. **Table 2–17** provides a list of signal names and a brief description for each digital input signal.

TABLE 2–17 DIGITAL INPUTS

Signal Name	Functional Description
FILA_EXIST	Filament current present (I_f1.5 A), active low
FOCUS_L	Feedback: large focus selected. active low
AEC_OVERCURRENT	Excessive current in the high voltage supply, active low
DOOR_INTERLOCK	Door contact examination room, door open, active low
SRC_A_COMMON_ LOCKOUT	Exposure inhibit (kV 49 without 50 kV filter), active low
PBL	Positive beam limitation (exposure inhibit), active low
NS_OK1	Normal speed rotating anode running, main phase OK, active low
NS_OK2	Normal speed rotating anode running, auxiliary phase OK, active low
HS_ROTOR_READY	High speed rotating anode nominal speed reached, active low
HS_ANODE_ROTATION	High speed rotating anode running, active low
TS_OK1	High voltage/filament connected to tube 0, active low
TS_OK2	High voltage/filament connected to tube 1, active low
TOMO_ANGLE0	Sweep angle bit 0, active low
TOMO_ANGLE1	Sweep angle bit 1, active low
TOMO_SPEED	Tomo speed slow/fast, active low
TOMO_SELECT_EX	External technique selection Tomography, active low
TABLE_SELECT_EX	External technique selection Table Bucky, active low
WALL_SELECT_EX	External technique selection Wall, active low
PREPARE	Exposure preparation, active low
EXPOSURE	Exposure release, active low

Table 2–18 provides a list of signal names and a brief description for each digital output signal.

TABLE 2–18 DIGITAL OUTPUTS

Signal Name	Functional Description
AEC_START(_OUT)	Start phototimer, active low
AEC_SUPPLY	Activate current supply photomultiplier, active low
AEC_LEFT	Select left measuring chamber (K5, K72), active low
AEC_CENTER	Select central measuring chamber (K4, K73), active low
AEC_RIGHT	Select right measuring chamber (K3, K74), active low
AEC_GAIN1	Film/screen detail, active low
AEC_GAIN2	Film/screen par-speed, active low
AEC_GAIN1/2	Enable amplification adjustment in pickup
MULTIPLIER	Low amplification during AEC with photomultiplier signal (K2), active low
READY_SIGNAL	Signal output system ready for radiation, active low
RADIATION_SIGNAL	Signal output radiation prolonged, active low
POWER_SUPPLY	24 V supply (K1 – line-ON switch), 110 V (K3 – line-ON switch), Filament supply (K2 – line ON-switch), active low
POWER_HOLD_MP	CPU self-holding the CPU supply (K1 on the line-ON switch 1174-23-S1), active low
WALL	Technique relay Wall (K361), active low
TABLE	Technique relay Table (K360), active low
TOMO	Technique relay Tomo (K362), active low
NS_SUPPLY	Supply for rotating anode normal speed, active low
NS_START	Start/continue impulse for normal speed rotating anode, active low
HS_START	Start/stop for high-speed starter, active low
ABOVE_49KV	Supply for SRC_A_COMMON_LOCKOUT 49 KV (K314), active low
KV_RANGE_C	Inverter operating mode with capacitor, active low
KV_RANGE_R	Inverter operating mode with resistance, active low
BUCKY_START	Inverter supply ON, exposure release (K323), active low
R485_ENABLE	RS485 driver switch ON (receive), active low
T485_ENABLE	RS485 driver switch ON (transmit), active low
TS_1	Changeover high voltage/filament to tube 0, active low
TS_2	Changeover high voltage/filament to tube 1, active low
TS_DRIVE	Changeover stator winding tube 0 and 1 active low

TABLE 2–18 DIGITAL OUTPUTS – CONTINUED

Signal Name	Functional Description
FOCUS	Changeover focus (0: small focus), active low.
FLUORO_SHUNT	mA-measuring range RAD (active) or fluoro, active low
CPU_ACTIVE	Activity indication of microprocessor, active low
PREP_OUT	Signal output generator in preparation (PREPARE), active low
ALE	Actual length of exposure, direct radiation signal, active low
MAS_CORRECTION	Short circuit for mA measurement output, active high

Table 2–19 provides a list of signal names and a brief description for each CPU I/O signal.

FILAMENT DRIVE PCB

The **Filament Drive** PCB (schematic diagram 1174-20-S1) receives 55Vac from transformer T01. This voltage is used to create a bi-polar 75V supply (±75V). These voltages are half-wave-rectified and filtered. LEDs CR9 and CR35 indicate that the +75V and -75V voltages are present, respectively.

The **Filament Drive PCB** receives +24Vdc from the Central Unit PCB at pin 6 of connector P35 and is indicated by LED CR31. The +24Vdc supply is used as the power source for relay K1 (FOCUS SELECT).

The ±15Vdc voltages are received from the **+5/±15V Power Supply PCB** at pins 1 and 2 of connector J33 through the wiring harness. The presence of these voltages is indicated by LEDs CR27 (+15Vdc) and CR29 (-15Vdc). These voltages are for general voltage supply purposes on the **Filament Drive PCB**.

The input signal FILA_NOM (nominal filament current value) on pin 11 of connector P35 is received from the CU (Central Unit) as a PWM signal. The PWM signal is then converted into an analog signal (0 to 10Vdc) through the filter circuit (ICs U1 and U2) and inverted at IC U5B. The output of IC U10B (filament current feedback) is applied to the input of IC U5A through a voltage divider.

These two signals (outputs of ICs U5A and U5B) are summed through the 20K resistors and applied to pin 16 of IC U6. The outputs of IC U6 (pins 4 and 5) are PWM signals that are proportional to the input voltage at a constant frequency of 20 kHz.

TABLE 2–19 CPU I/O DEFINITIONS

Signal Name	Functional Description
MP_EXP_START	Output, start signal for exposure at EPC (CC1) active low
INTRS485	Input, listening at reception of SIO0 (INT5), active low
INV_START_TEST	Input, EPC inverter start signal feedback to the CPU (INT6), active low
FAILURE_STOP	Input, of EPC: exposure end by error (INT2), active low
MA_EXIST	Input, radiation present (anode current mA), active low
MA_ACT	Input, counter input of T2, anode current actual value active high
BUCKY_CONTACT	Input, feedback from bucky started exposure
POWERFAIL_1 5V	Input, insufficient voltage at +15 V, -15 V (INT1), active low
FILA_NOM	PWM output, nominal value filament current
FILA_NOM_LIM	PWM output, nominal value filament current limit
KV_NOM_INV	PWM output, nominal value high voltage for inverter
KV_PRESET	PWM output, nominal value operating point of the inverter
AEC_DENSITY	PWM output, comparator threshold of phototimer (AEC unit)
FILA_OVER	(EPC) input, exceeding HW (HW switched off), active low
MA_ERROR	(EPC) input, radiation after the exposure (HW switched off), active low
MA_ERROR_ANODE	(EPC) input, excessive current,. anode (HW switched off), active low
MA_ERROR_CATHODE	(EPC) input, excessive current, cathode (HW switched off), active low
KV_OVER	(EPC) input, excessive voltage (150KV +10%) (HW switched OFF), active low
KV_WD_TIMEOUT	(EPC) input, KV watchdog not triggered (HW switched off), active low
AEC_STOP	(EPC) input, exposure end by AEC, active low
CONSOLE_ON	(EPC) input, console is ON (current flow), active low
FILA_LIM	Input, HW = limit (limits regulator in HW/SW), active low
KV_75	Input, KV75% KV_NM_INV, active low
INV_GATE_ENABLE	Output, release INV_start and inverter thyristors, active low
MA_ERROR_ENABLE	Output, activate detector radiation after exposure, active high
KV_WD	Output, trigger KV watchdog, active low

Driver ICs U7 and U8, controlled by these output signals, supply transformer T3 in PUSH-PULL operation. FETs Q1 and Q2 are alternately controlled by the secondary windings of transformer T3 and accordingly, connect 20 kHz, +75 V or -75 V to the primary winding of the filament transformer through transformers T2 and T1, relays K2D and K1D/C and the selected primary windings of the filament transformer. The resulting current generates a proportional voltage signal at transformers T1 and T2. The signal at transformer T1 is rectified and, in the event of a filament overcurrent, energizes relay K2. The filament overcurrent (FILA_OVER) is indicated by LED CR17. Section D of relay K2 opens the circuit to the filament transformer.

Section E of relay K2 causes relay K2 to self-latch, which is resettable only by removing and re-applying power to the system. Section C of relay K2 connects feedback signals to the CU and to relay K53 (safety relay).

IC U9 is an RMS-to-DC converter which generates a dc signal proportional to the actual filament current (FILA_CURRENT) from the signal at transformer T2 (1V = 1A at pin 8 of IC U9).

Input signal FILA_NOM_LIM (filament current limit value) on pin 9 of connector P35 is received from the CU as a PWM signal. This signal is then converted into an analog signal (0 to 10Vdc) through the filter circuit (ICs U3 and U4) and applied to IC U10A.

IC U10A compares the actual filament current signal (FILA_CURRENT) with the filament current limit value (FILA_NOM_LIM) signal. If the actual voltage should exceed or equal FILA LIM, then U10A-1 provides a limiting signal to the summation point R41, R44, R67 and inhibits further increase in the filament current. At the same time, CR23 indicates FILA DRIVE LIMITATION (filament current limitation) through Q3.

The buffered output signal from pin 8 of IC U9 is applied to the base of transistor Q4. This signal turns the transistor ON which in turn provides the /FILA_EXIST signal (filament current is present) at approximately 1.5 Amps to the Digital Inputs section of the Central Unit. The status indication for this function is provided through LED CR26.

The buffered output signal from pin 8 of IC U9 is also applied to pin 6 of IC U10B. This signal is inverted (- 1 V = 1 A) and is applied as a summing component to IC U5A through resistor R29. At this point, the actual voltage is compared with the nominal voltage (FILA NOM). If a difference is detected, IC U5A provides a correction signal as a summing component to IC U6 through resistor R44 which effectively counteracts any differences between actual and nominal filament values.

ANODE STATOR PCB

For discussion of **Anode Stator PCB** theory, refer to Schematic Package schematic number 1174-24-S1.

The Anode Stator PCB receives 240Vac directly from main line contactor relay K01. The relay section of the Central Unit supplies +24Vdc to the Anode Stator PCB through safety relay K53.

At exposure start, relay K1 on the stator circuit PCB is actuated by "NS-SUPPLY" 45 ms earlier than Q1 by "NS-START". The contacts of K1 are therefore switched under no load. When the generator is turned OFF, this sequence is reversed.

The main phase current flow caused by the 240Vac supply generates a voltage drop across resistor R15 that is limited by the diode array consisting of diodes CR14 through CR17. This voltage reaches the diode of the optocoupler (IC U2A) at a frequency of 60 Hz. The optocoupler provides a logic level LOW input to pin 2 of operational amplifier IC U1B. The transition charges capacitor C1 through the resistor-diode network of R10, CR9, and R9. The integral voltage at capacitor C1 generated by the charging impulses keeps the input of IC U1F (pin 6) at a logic level HIGH or the output (pin 11) at a logic level LOW (signal NS_OK 1). LED CR19 (MAIN) is the associated status indicator.

The auxiliary phase current flow caused by the 240Vac supply generates a voltage drop across resistor R14 that is limited by the diode array consisting of diodes CR10 through CR13. This voltage reaches the diode of the optocoupler (IC U2B) at a frequency of 60 Hz. The optocoupler provides a logic level LOW input to pin 1 of operational amplifier IC U1A. The transition charges capacitor C2 through the resistor-diode network of R11, CR8, and R6. The integral voltage at capacitor C2 generated by the charging impulses maintains the input of IC U1E (pin 5) at a logic level HIGH or the output (pin 12) at a logic level LOW. LED CR19 (AUX) is the associated status indicator.

CONTROL PANEL PCB

For discussion of **Control Panel PCB** theory, refer to Schematic Package schematic number 1174-20-S1.

The control panel PCB is comprised of seven functional units. Each of the seven functional units are described individually in the paragraphs that follow.

The connection to the generator Central Unit is made through connector B1. In addition to the serial connection to the generator Central Unit, this connector (pin 9) also carries the 24Vdc supply voltage.

Power Supply

The control panel PCB receives power (24Vdc) from the Central Unit by way of the serial interface cable. However, it contains its own voltage regulator for the required 5Vdc supply. The power ON switch on the panel is connected to points E5 and E6. When ON is pressed, relay K1 is energized and places itself into a self-holding state. When the control panel is switched ON, the Power ON/OFF PCB receives a 24Vdc current signal and energizes the supply of the generator central unit.

The 24Vdc supply voltage received at pin 9 of connector B1 is applied to a dc regulator (IC U20) and isolated by transformer L1 and is reduced to 5Vdc.

The status indication for the presence of the 24Vdc supply is provided by LED CR10 and the status indication for the presence of the 5Vdc supply is provides by LED CR12.

Relay K1 (power on) remains energized until the power off switch on the control panel panel is pressed which de-energizes relay K1. When the control panel is switched OFF, the 24Vdc current signal is removed from the Power ON/OFF PCB and de-energizes the supply of the generator central unit.

Processor

The processor of the control panel PCB is the same as that of the Central Unit (CU) PCB. For a description of the operation of the control panel PCB processor, refer to the theory discussion of the processor for the CU PCB.

Interface to Panel Switches

The connectors E, F and G provide the connections to the control panel keys. The APR keys are connected through connector F.

With the exception of the PREP, EXPOSE, ON and OFF keys, all other keys are connected as a keyboard matrix and are cyclically polled by the processor IC U6.

The matrix columns (TS0 through TS7) are controlled from processor pins 61 through 68 (port P5.0 through P5.7) and connected to the switches, decoupled through diodes CR1 through CR8. The matrix rows (TZ0 through TZ7) are evaluated by processor pins 13 through 20 (port P7.7 through P7.0).

Panel switches PREP (pin connections E1 and E2) and EXPOSE (pin connections E3 and E4) control the inverter IC U11, and are evaluated directly by the processor. Processor port P3.2 evaluates the EXPOSE switch and port P3.3 evaluates the PREP switch. An optional hand expose switch may be connected to connectors X1, X2 and X3.

Jumpers JP16 and JP17 provide the option to activate PREP and EXPOSE either from the hand switch or from the control panel. The power on and power off keys on the control panel (pin connections E5 and E6 and pin connections E7 and E8, respectively) turn the system ON and OFF.

Interface to LEDs

The connectors F and G provide the connections to the control panel LEDs. The APR LEDs are connected through connector F.

The panel indicators (LEDs) are controlled by display driver IC U12. Display driver IC U12 is programmed by means of processor pin 1 (DIN), pin 2 (CLK2) and pin 3 (LOAD2). The LEDs are connected as a matrix in which the signals Sc0 through Sc7 control the LED rows and the signals Dlc0 through Dlc7 control the LED columns.

The brightness of the LEDs is controlled with potentiometer R25.

Seven-Segment Display Control

The seven-segment display is controlled by the display control ICs U7 and U8, which are programmable by the processor IC U6. Display driver ICs U7 and U8 are programmed by means of processor pin 1 (DIN), pin 5 (CLK1) and pin 6 (LOAD1).

The brightness of the 7-segment displays is controlled with potentiometers R21 and R23.

Audible Output Control

A logic level LOW signal from processor pin 35 (port P1.1) is applied to the input of inverter IC U11A. The logic level HIGH output of this inverter causes speaker LS1 to sound. The volume of the speaker is controlled with potentiometer R19.

Serial Interface

Communication with the generator central unit takes place through a serial interface connected to the 9-pin D-shell connector B1. It is controlled by processor pins 21 and

22 (RxD0 and TxD0) depending upon configuration of jumpers J3, J4 and J5. The signal levels of these signals are converted into RS232 levels by driver IC U5.

In addition to the signals for the serial interface, a 24Vdc supply is also connected to the control panel through connector B1 pin 9.

INVERTER

The **Inverter** (schematic diagram 1181-S12) receives power from the intermediate power circuit and includes the bridge circuit of the thyristors CR1 through CR4, the primary winding of the high-tension transformer, and the oscillating circuit capacitors C1 and C2.

The thyristor bridge is switched in continual oscillation through the corresponding control circuits in the transformer PCB, so that the primary winding, which is in series with the capacitors of the resonance circuit, can oscillate with a resonant frequency of approximately 8 kHz for the duration of the exposure. All conditions for the control of the inverter reside in the IVC portion of the IVC circuit PCB.

When the exposure key is actuated, K02 connects the intermediate circuit directly to the line to transmit the power (the contacts of K01 are then closed).

HIGH-TENSION TRANSFORMER

The tank of the high-tension transformer contains the transformer, with its two secondary windings connected to the high-tension rectifier and to the capacitors for the voltage-doubling circuit.

Each of the capacitors of the four branches for the voltage doubling function consists of 8 single capacitors of 0.25nF each, connected in series. The capacity per branch is 31nF, so that the total capacity in the high-tension circuit is 8nF.

In addition to the high-tension power circuit, the tank also contains two resistors of 220 MΩ each for the voltage divider as feedback to the kV regulating circuit and the filament transformer for the supply of the double-focus x-ray tube.

CALIBRATION

INTRODUCTION

This section provides the instructions necessary to properly calibrate the Clinix VP4 Generator. Calibration of the Clinix VP4 Generator consists of using the internal service program by way of the control panel to setup and configure the information used by the Clinix VP4 Generator in the non-volatile RAM (NVRAM) memory.

The service program is used to provide communication with the microprocessor control circuits of the Clinix VP4 Generator, and to load, manipulate, and save generator configurations.

SPECIAL TOOLS AND EQUIPMENT

The following is a list of the special tools and/or equipment required for proper calibration of the Clinix VP4 Generator system:

1. Standard Service Tool Kit.

SAFETY INFORMATION

All personnel are cautioned to observe all CAUTIONS and WARNINGS as they appear throughout the text of this section. Failure to comply may result in serious or fatal bodily injury to service personnel.

SERVICE MODE GENERAL INFORMATION

ENTERING SERVICE MODE

1. To enter service mode, press and hold the **BUT** key for a minimum of six (6) seconds until the **BUT** indicator illuminates.

2. Within three (3) seconds after the **BUT** indicator illuminates, release the **BUT** key and press and release it again and the **BUT** indicator will blink.

3. The generator is now in the service mode.

EXITING SERVICE MODE

There are two (2) methods of exiting service mode in the Clinix VP4 generator:

1. Press and hold the **BUT** key until the **BUT** indicator stops blinking (extinguished);

or;

2. Remove power from the generator by pressing the **O** (off) key on the control panel and re-apply power normally.

USING SERVICE MODE

All service mode operations are accessible by way of the control panel controls. There are three (3) different operational stages under which the control panel controls the generator . That is, a single control may have multiple uses, depending upon which operational stage (or level of service) the system is currently in. The three operational stages are defined as shown in **Table 3–1**.

TABLE 3–1 OPERATIONAL STAGES OF SERVICE MODE

Stage	Active Keys	Description
Main Function	APR Set	Allows service personnel to select the desired calibration function such as: set-up; tube calibration; phototimer calibration; etc.
Sub Function	kV + and –	Allows service personnel to step through the function tree to the desired sub function.
Value/Selection	APR Set/ mAs + and –	Allows service personnel to change parameters of the currently displayed sub function or to enter a numeric value when required.

The LED indicator of the selected function illuminates when selected. A main function is terminated by pressing the appropriate function key again. If no function is selected, the focal spot, screen, AEC function, kV, mAs and long time may be selected by using the normal selection keys.

Sub functions of a main function are selected with the **kV +** or **kV –** keys. The sub function is indicated by a number in the kV display. Stepping through the function tree causes no functions to be executed, so that no settings can be changed inadvertently. If a function is to be executed, it must first be activated by pressing the **Accept** key (**APR$_{14}$**), or by changing the displayed value using the **mAs +** or **mAs –** keys, or by inputting the numerical input.

Selecting A Main Function

Each **APR** key (1 through 14) on the control panel is assigned a different main function as shown in **Table 3–2**.

TABLE 3–2 MAIN FUNCTION SELECTIONS

APR Key	Function
APR_1	Set-up
APR_2	View and change parameters
APR_3	Automatic tube calibration
APR_4	Single point calibration
APR_5	Phototimer
APR_6	Fault diagnosis
APR_7	N/A
APR_8	N/A
APR_9	N/A
APR_{10}	N/A
APR_{11}	N/A
APR_{12}	N/A
APR_{13}	Numerical input
APR_{14}	Accept

NOTE

The **APR** keys are number 1 through 14 (denoted by a subscript) beginning from the top of the control panel to the bottom.

Press the appropriate **APR** key for the desired main function and predefined sub functions will become available for the selected main function.

Selecting A Sub Function

The **APR** keys on the control panel are assigned different function depending upon the selected main function.

The sub function selection is made by pressing the **kV +** and **kV –** keys to select the desired sub function. The definition of these sub functions are defined in the appropriate procedures later in this section.

Numerical Input

Some sub functions require entering a numerical value. A number can be directly entered by pressing **APR$_{13}$** to change the APR keys to the Numerical Input Mode (see **Table 3–2**) and then using the appropriate keys for the desired value. The key definitions are provided in **Table 3–3**.

TABLE 3–3 NUMERICAL INPUT KEYS

APR Key	Function
APR$_1$	1
APR$_2$	2
APR$_3$	3
APR$_4$	4
APR$_5$	5
APR$_6$	6
APR$_7$	7
APR$_8$	8
APR$_9$	9
APR$_{10}$	0
APR$_{11}$	N/A
APR$_{12}$	Delete last digit (number)
APR$_{13}$	Discard changes and quit
APR$_{14}$	Accept changes and quit

When the numerical input mode is active (**APR$_{13}$**), the APR LED indicators illuminate. The numbers 1 to 9 and 0 are entered through APR keys 1 through 10. The last digit (number) can be deleted using **APR$_{12}$**. The numerical input mode is terminated using **APR$_{13}$** or **APR$_{14}$**. **APR$_{13}$** discards changes and **APR$_{14}$** accepts the changes as displayed.

SERVICE MODE

This paragraph provides the sequential use of the system in service mode and the required actions to fully calibrate the Clinix VP4 Generator system. Each calibration function is divided into separate paragraphs for easy usage and reference.

SET-UP (APR$_1$)

The Set-up function should not be performed unless one of the following is true of the contents of the NVRAM.

- a software update has been installed,
- the exposure counter is to be reset after a tube replacement,
- there is reason to suspect that the NVRAM may contain undefined data following an equipment problem.

1. To select **set-up**, the system must be in service mode. Refer to **Entering Service Mode** in **Service Mode General Information**.
2. After entering service mode, press control panel key **APR$_1$**.
3. Using the **kV +** and **kV –** keys, select the Clinix VP4 sub function.

NOTE

The available sub functions are listed and described in **Table 3–4**, but should not be required for use in the Clinix VP4 system, unless an equipment change has been made.

TABLE 3–4 SET-UP SUB FUNCTIONS

Sub Function	Default Value	Options	Description
Display/Change Power	50 kW	40 kW/50 kW	The maximum power is displayed in the ms display. The **mAs +** and **mAs –** keys can be used to toggle back and forth between the values.
Display/Change Line Frequency	50 Hz	50 Hz/60 Hz	The nominal value of the line frequency is displayed in the ms display. The **mAs +** and **mAs –** keys can be used to toggle back and forth between the values.
Display/Change Maximum kV	125 kV	125 kV/150kV	The maximum kV value is displayed in the ms display. The **mAs +** and **mAs –** keys can be used to toggle back and forth between the values.
Display/Change Tube Type	PX1429	PX1429/PX1351	The model name of the x-ray tube is displayed in the ms display. The **mAs +** and **mAs –** keys can be used to toggle back and forth between the values.
Erase NVRAM	N/A	N/A	Allows erasure of NVRAM contents.
Clinix VP4	N/A	N/A	Configures generator with specific Clinix VP4 values (see **Tables 3–5** and **3–6**).

4. Erasure of the NVRAM contents is accomplished by pressing the **APR**$_{14}$ (accept) key, and is indicated by the number 1 displayed in the ms display. Specifically, the APR, AEC and filament data revert to the default values, that is, the previously selected data is overwritten.

TABLE 3–5 APR PROGRAMMING FOR TABLE BUCKY

APR No.	kV	mAs	Focus	ms	ms Tomo	AEC	Field	Screen	Density	Text No.	Text
1	65	100	L	min	-	Y	C	1	0	10	SKULL
2	60	80	L	min	-	Y	C	1	0	11	SKULL LAT
3	66	100	S	min	-	Y	C	1	0	20	UPPER RIBS AP/PA
4	63	100	S	min	-	Y	C	1	0	21	LOWER RIBS AP/PA
5	57	100	S	min	-	Y	C	1	0	22	STERNUM
6	60	64	S	min	-	Y	C	1	0	66	SHOULDER JOINT AP
7	63	160	S	min	-	Y	C	1	0	51	CERVICAL SPINE AP
8	66	320	L	min	-	Y	C	1	0	56	THORACIC SPINE AP
9	73	320	L	min	-	Y	C	1	0	57	THORACIC SPINE LAT
10	72	320	L	min	-	Y	C	1	0	58	LUMBAR SPINE AP
11	75	320	L	min	-	Y	C	1	0	0	LUMBAR SPINE LAT
12	75	200	L	min	-	Y	C	1	0	0	HIP JOINT AP
13	73	250	L	min	-	Y	R	1	0	62	PELVIS
14	70	250	L	min	-	Y	C	1	0	63	COCCYX AP

5. Selecting the Clinix VP4 sub function causes the NVRAM to be erased, and the following default values, which are different from the normal default values, are written to the NVRAM:

   a. Generator power: 40 kW

   b. Maximum tube voltage: 125 kV

   c. mAs range: 2.0 to 320 mAs

   d. Wall Technique: inhibited

   e. APR programming: Specific

TABLE 3–6 APR PROGRAMMING FOR TABLETOP

APR No.	kV	mAs	Focus	ms	ms Tomo	AEC	Field	Screen	Density	Text No.	Text
1	80	20	L	min	-	N	-	-	-	0	ABDOMEN PA
2	70	10	S	min	-	N	-	-	-	11	SKULL LAT
3	45	4	S	min	-	N	-	-	-	0	FINGER
4	45	4	S	min	-	N	-	-	-	0	HAND AP
5	48	4	S	min	-	N	-	-	-	0	WRIST AP
6	60	4	S	min	-	N	-	-	-	0	FOREARM AP
7	60	4	S	min	-	N	-	-	-	0	ELBOW AP
8	65	4	S	min	-	N	-	-	-	0	UPPER ARM AP/LAT
9	70	4	S	min	-	N	-	-	-	0	SHOULDER AP
10	70	4	S	min	-	N	-	-	-	0	KNEE AP/LAT
11	55	4	S	min	-	N	-	-	-	0	MIDDLE FOOT
12	80	80	L	min	-	N	-	-	-	0	HIP/FEMUR LAT
13	60	4	S	min	-	N	-	-	-	0	ANKLE (AP/LAT)
14	45	4	S	min	-	N	-	-	-	0	TOES

NOTE

APR programming is defined for the table bucky and for a table top bucky (accessories) as shown in **Tables 3–5** and **3–6**.

These parameters may be changed at the specific unit's request, however, these values will remain as the default.

VIEW AND CHANGE PARAMETERS (APR$_2$)

The **View and Change Parameters** selection in the main function group is used to select all variable parameters that are not defined in the set-up selection.

1. To select **View and Change Parameters**, the system must be in service mode. Refer to **Entering Service Mode** in **Service Mode General Information.**
2. After entering service mode, press the **APR$_2$** key on the control panel.

3. Using the **kV +** and **kV –** keys, select the desired sub function. The available sub functions are listed and described in **Table 3–7**.

TABLE 3–7 VIEW AND CHANGE PARAMETER SUB FUNCTIONS

Sub Function	Default Value	Options	Description
Reduce power to 20 kW	As selected in setup	As selected in setup/20 kW	The maximum generator power selected in set-up (**APR$_1$**) can be reduced to 20 kW to allow operation on a poor line. The **mAs +** and **mAs –** keys are used to select the generator power displayed in the ms display.
Limit kV to 100 kV	As selected in setup	As selected in setup/100 kV	The maximum kV selected in set-up (**APR$_1$**) can be reduced to 100 kV to allow operation with old x-ray tubes. The **mAs +** and **mAs –** keys are used to select the reduced maximum kV displayed in the ms display.
Set lowest mAs step	2.5 mAs	Less than highest mAs step	The ms display displays the lowest selectable mAs value. The **mAs +** and **mAs –** keys can be used to select a different mAs step. The value must be less than than the highest mAs step.
Set highest mAs step	500 mAs	Greater than lowest mAs step	The ms display displays the highest selectable mAs value. The **mAs +** and **mAs –** keys can be used to select a different mAs value. The value must be greater than the lowest mAs step.
Inhibit large/ small focus	None	None/ Small/ Large/ Both	The large or small focus can be inhibited, to allow using the system even when one focal spot is defective. A usable focus is indicated by the focal spot LED assigned to it. The **mAs +** and **mAs –** keys can be used to toggle between the selections.
Inhibit wall technique	0 (Inhibited)	0 (Inhibited)/ 1 (Selected)	Wall Technique may be inhibited so that when the Wall Technique key is pressed, Wall Technique is not selected. The **mAs +** and **mAs –** keys can be used to toggle between the selections.
Set time step for long time exposure	1000 ms	1000 ms/ 1450 ms/ 2500 ms	The mAs display shows the number of the long-time memory (1 to 3); the ms display shows the time in ms. The **mAs +** and **mAs –** keys can be used to select a time step from the time table. Key **APR$_{14}$** is used to toggle to the next long-time memory.

4. Once the desired sub function is displayed, make changes using the **mAs +** and **mAs –** keys.

5. Repeat steps **3** and **4** as necessary.

6. When changes are complete, press the **APR$_2$** key to exit.

AUTOMATIC TUBE CALIBRATION (APR3)

1. Enter service mode. Refer to **Entering Service Mode** in **Service Mode General Information**.

2. Using the control panel keys, select table bucky technique and desired focal spot.

3. Press the **APR3** key to select Tube Calibration. The tube voltage is displayed in the kV display, the tube current in the mAs display, and the filament current in the ms display.

CAUTION

DO NOT PRESS THE **APR14** KEY UNLESS FULL CALIBRATION OF THE FILAMENT IS DESIRED. PRESSING THE **APR14** KEY WILL MARK ALL FILAMENT CALIBRATION POINTS AS UNCALIBRATED. PRESS **APR3** TO ABORT.

4. Press the **APR14** key to enter automatic tube calibration mode. The tube voltage is displayed in the kV display, the tube current in the mAs display, and the number of calibration exposures for each calibration point will be displayed the ms display.

5. Press and hold the exposure key. The ms display will step through the number of calibration exposures for each calibration point. As each point is calibrated, the kV and mAs displays will display the values for the next calibration point and the ms display will begin the calibration exposure counter for that point.

NOTE

It is permissible to release the exposure key during the automatic calibration. Calibration will begin again at the point first uncalibrated point when the exposure key is pressed again.

6. Hold the exposure key until all points have been calibrated.

7. If a point cannot be calibrated within the defined number of calibration exposures, an error message (E800) is displayed in the ms display. Press the **mAs +** key to skip the current calibration point and begin again with the next uncalibrated point.

8. When automatic calibration is complete, press the **APR$_3$** key to complete automatic tube calibration.

9. If it is desired to calibrate the other focal spot, select it and press the **APR$_3$** key. Repeat steps 4 through 8.

SINGLE POINT CALIBRATION (APR$_4$)

1. Enter service mode. Refer to **Entering Service Mode** in **Service Mode General Information**.

2. Using the control panel keys, select table bucky technique and desired focal spot.

3. Press the **APR$_4$** key to select Tube Calibration. The tube voltage is displayed in the kV display, the tube current in the mAs display, and the filament current in the ms display. If the filament current value is flashing, the data point is uncalibrated.

4. Calibrated or uncalibrated points may be selected for point calibration. Depending upon the desired type to calibrated, perform one of the two following steps:

   a. If uncalibrated point(s) are desired for single point calibration, use the **mAs +** and **mAs -** keys to step through the uncalibrated points and stop on the desired point. Clear existing data by pressing the **APR$_{14}$** key.

   b. If calibrated point(s) are desired for single point calibration, use the **kV +** and **kV -** keys to step through the calibrated points and stop on the desired point. Clear existing data by pressing the **APR$_{14}$** key.

5. The tube voltage is displayed in the kV display, the tube current in the mAs display, and the filament current is displayed the ms display.

6. There are two methods available for calibration at this point. Perform one of the following steps, depending upon what is desired.

   a. Press and hold the exposure key. The ms display will step through the number of calibration exposures for the selected calibration point.

   b. Press the **APR$_{13}$** key to allow the numerical input of the filament current for the selected calibration point and enter the desired number. Refer to **Table 3–3**.

7. If a point cannot be calibrated within the defined number of calibration exposures, an error message (E800) is displayed in the ms display. This point will required numerical input.

8. When the single point calibration is complete, exit by pressing the **APR$_4$** key or calibrate another point by repeating steps **4** through **7**.

PHOTOTIMER (AEC) CALIBRATION (APR$_5$)

Introduction

The purpose of calibrating the phototimer is to ensure that the generator selects an exposure termination voltage for the phototimer as a function of kV, so that uniform film blackening (optical density) is achieved regardless of kV. To make this possible, the exposure termination voltage can be defined at 10 kV intervals. At intervening kV points, the generator interpolates the exposure termination voltage. The sub functions available under phototimer calibration are as shown in **Table 3–8**.

TABLE 3–8 PHOTOTIMER CALIBRATION SUB FUNCTIONS

Sub Function	Default Value	Options	Description
Inhibit Phototimer	1 (Available)	0 (Inhibited)/ 1 (Available)	The phototimer status is displayed in the ms display. The **mAs** + and **mAs** – keys can be used to toggle back and forth between the values.
Select Pickup model	1 (SSD)	0 (PMT/ION)/ 1 (SSD)	The pickup model type is displayed in the ms display. The **mAs** + and **mAs** – keys can be used to toggle back and forth between the types.
Film-Screen Sensitivity	1: 400 2: 200 3: 100	—, 50, 100, 200, 400, 800, or 1600 (each screen)	The mAs display shows the screen number (1, 2, 3); the ms display shows the film sensitivity (—, 50, 100, 200, 400, 800, 1600). The **mAs** + and **mAs** – keys can be used to select the screen number (1,2,3). Press the **APR$_{14}$** key to select the next higher sensitivity. Press the **APR$_{12}$** key to select the next lower sensitivity.
Exposure Termination Voltage	7500 mV	Numerical Input (0 to 9999)	The exposure termination voltage is displayed in the ms display. The value can be changed after pressing **APR$_{13}$**.
Display/Change Exposure Termination Voltage	50 kV	Numerical Input (0 to 9999)	The mAs display shows the kV step and the ms display shows the exposure termination voltage in mV. The **mAs** + and **mAs** – keys can be used to toggle back and forth between the values.

The nominal value of the optical density is required during calibration involving amplification of pickup signal, and coarse and fine adjustments. A standard value of 1.20 plus fog is recommended.

Backup mAs is the maximum mAs permissible for an exposure. If the exposure has not been terminated by the phototimer when this mAs value is reached, the mAs integrator interrupts the exposure, and the generator enters the BUT condition. The backup mAs should be selected to avoid this condition. The recommended value at screen speed 100 is 100 mAs.

Calibration of First Screen

1. Place at least 10 cm of absorber in the center of the x-ray field.
2. Enter service mode. Refer to **Entering Service Mode** in **Service Mode General Information**.
3. If it is not already on, turn on AEC (indicator illuminated).

NOTE

> If calibrating more than one screen, calibrate the slowest screen first.

4. Using the control panel keys, select small focus, center field and the desired screen (normally **Screen 2**).

NOTE

> As long as the screen key is depressed the programmed film/screen speed is displayed in the **ms** display.

5. Verify that the expected screen speed is displayed. If not, make changes in accordance with **Table 3–8**.
6. Select backup mAs using the **mAs +** and **mAs -** keys (320 mAs is recommended).
7. On the control panel, press the **APR$_5$** key.
8. If necessary, using the **kV +** and **kV -** keys, select Default Exposure Termination. The number **4** will appear in the **kV** display.
9. If necessary, set to 50 kV using the **mAs +** and **mAs -** keys. The kV value is displayed in the **mAs** display.
10. The Termination Value shown in the ms display should be 7500. If necessary, set the Termination Value to 7500 by pressing **APR$_{13}$** (to select data

entry mode) then the four digits (**APR**$_7$, **APR**$_5$, **APR**$_{10}$, **APR**$_{10}$). When the value 7500 is correctly displayed in the ms display, press the accept key, **APR**$_{14}$.

NOTE

Rounding errors may change the least significant digit. That is, if 7500 was entered 7501 may be displayed.

11. Make test film(s) as follows:

    a. Press the **APR**$_{14}$ key to prepare for exposure (Termination Value will blank from the display and kV and backup mAs will be displayed as normal).

    b. Insert appropriate film cassette into bucky and make an exposure.

NOTE

All exposures should be kept to 20ms or greater. Add absorber as necessary to maintain the exposure time.

    c. Develop the film and measure density with a densitometer. **RECORD** this **Measured Density** value in **Table W–1** of the **Calibration Worksheet**.

NOTE

It is not required to fill the entire table. Additional lines in the table are for exposures as required to achieve a density reading between 1.2 and 1.4.

    d. If density is not between 1.2 and 1.4, adjust potentiometer R106 on the CPU PCB (clockwise to decrease exposure).

    e. Repeat steps **b** through **d** as necessary.

12. Press the **APR**$_{14}$ key to display the Termination Value in the ms display.

13. Using the **mAs +** and **mAs -** keys, set generator for a 70kV exposure.

14. Press the **APR**$_{14}$ key to return to the exposure mode (ms display blank).

15. Insert appropriate film cassette into bucky and make an exposure.

16. Develop the film and measure density with a densitometer. RECORD this **Measured Density** value in **Table W–2** of the **Calibration Worksheet**.

NOTE

It is not required to fill the entire table. Additional lines in the table are for exposures as required to achieve a density reading between 1.2 and 1.4.

17. If the **Measured Density** is between 1.2 and 1.4, proceed with step **20**, otherwise, perform the following:

    a. Press the **APR$_{14}$** key to display the Termination Value in the ms display. RECORD this **Old Termination** value in **Table W–2** of the **Calibration Worksheet**.

    b. Divide the **Target Density** (1.30) by the **Measured Density** and RECORD this **Ratio** value in **Table W–2** of the **Calibration Worksheet**.

    c. Multiply this result (Ratio) by the **Old Termination** value to get the **New Termination** value. RECORD this **New Termination** value in **Table W–2** of the **Calibration Worksheet**.

    d. Press the **APR$_{13}$** key to enter data entry mode (indicators adjacent to **APR$_{1}$** through **APR$_{10}$** illuminated).

    e. Using the appropriate APR keys (**APR$_{1}$** through **APR$_{10}$**), enter the **New Termination** value recorded in **Table W–2**.

    f. Press the **APR$_{14}$** key to accept the entered value (indicators adjacent to **APR$_{1}$** through **APR$_{10}$** extinguished).

NOTE

If an error is made on entry, accept the erroneous information by pressing the **APR$_{14}$** key (step **f**) and repeat steps **d** through **f**.

    g. Press the **APR$_{14}$** key again to enter exposure mode (ms display blank).

    h. Insert appropriate film cassette into bucky and make an exposure.

   i. Develop the film and measure density with a densitometer. RECORD this **Measured Density** value in **Table W–2** of the **Calibration Worksheet**.

   j. If the density is between 1.2 and 1.4, proceed with step **20**, otherwise, repeat steps **a** through **i**.

18. Press the **APR$_{14}$** key to display the Termination Value in the ms display. RECORD this **Final Termination** value in **Table DS–1** of the **Calibration Data Sheet** for **Screen 2** at **70kV**.

19. Using the **mAs +** and **mAs -** keys, set generator for a 90kV exposure.

20. Press the **APR$_{14}$** key to return to the exposure mode (ms display blank).

21. Insert appropriate film cassette into bucky and make an exposure.

22. Develop the film and measure density with a densitometer. RECORD this **Measured Density** value in **Table W–3** of the **Calibration Worksheet**.

NOTE

It is not required to fill the entire table. Additional lines in the table are for exposures as required to achieve a density reading between 1.2 and 1.4.

23. If the **Measured Density** is between 1.2 and 1.4, proceed with step **26**, otherwise, perform the following:

    a. Press the **APR$_{14}$** key to display the Termination Value in the ms display. RECORD this **Old Termination** value in **Table W–3** of the **Calibration Worksheet**.

    b. Divide the **Target Density** (1.30) by the **Measured Density** and RECORD this **Ratio** value in **Table W–3** of the **Calibration Worksheet**.

    c. Multiply this result (Ratio) by the **Old Termination** value to get the **New Termination** value. RECORD this **New Termination** value in **Table W–3** of the **Calibration Worksheet**.

    d. Press the **APR$_{13}$** key to enter data entry mode (indicators adjacent to **APR$_{1}$** through **APR$_{10}$** illuminated).

    e. Using the appropriate APR keys (**APR$_{1}$** through **APR$_{10}$**), enter the **New Termination** value recorded.

f. Press the **APR**$_{14}$ key to accept the entered value (indicators adjacent to **APR**$_{1}$ through **APR**$_{10}$ extinguished).

NOTE

If an error is made on entry, accept the erroneous information by pressing the **APR**$_{14}$ key (step **f**) and repeat steps **d** through **f**.

g. Press the **APR**$_{14}$ key again to enter exposure mode (ms display blank).

h. Insert appropriate film cassette into bucky and make an exposure.

i. Develop the film and measure density with a densitometer. **RECORD** this **Measured Density** value in **Table W–3** of the **Calibration Worksheet**.

j. If the density is between 1.2 and 1.4, proceed with step **26**, otherwise, repeat steps **a** through **i**.

24. Press the **APR**$_{14}$ key to display the Termination Value in the ms display. **RECORD** this **Final Termination** value in **Table DS–1** of the **Calibration Data Sheet** for **Screen 2** at **90kV**.

25. Using the **mAs +** and **mAs -** keys, set generator for a 110kV exposure.

26. Press the **APR**$_{14}$ key to return to the exposure mode (ms display blank).

27. Insert appropriate film cassette into bucky and make an exposure.

28. Develop the film and measure density with a densitometer. **RECORD** this **Measured Density** value in **Table W–4** of the **Calibration Worksheet**.

NOTE

It is not required to fill the entire table. Additional lines in the table are for exposures as required to achieve a density reading between 1.2 and 1.4.

29. If the **Measured Density** is between 1.2 and 1.4, proceed with step **32**, otherwise, perform the following:

a. Press the **APR_{14}** key to display the Termination Value in the ms display. RECORD this **Old Termination** value in **Table W–4** of the **Calibration Worksheet**.

b. Divide the **Target Density** (1.30) by the **Measured Density** and RECORD this **Ratio** value in **Table W–4** of the **Calibration Worksheet**.

c. Multiply this result (Ratio) by the **Old Termination** value to get the **New Termination** value. RECORD this **New Termination** value in **Table W–4** of the **Calibration Worksheet**.

d. Press the **APR_{13}** key to enter data entry mode (indicators adjacent to **APR_1** through **APR_{10}** illuminated).

e. Using the appropriate APR keys (**APR_1** through **APR_{10}**), enter the **New Termination** value recorded.

f. Press the **APR_{14}** key to accept the entered value (indicators adjacent to **APR_1** through **APR_{10}** extinguished).

NOTE

If an error is made on entry, accept the erroneous information by pressing the **APR_{14}** key (step **f**) and repeat steps **d** through **f**.

g. Press the **APR_{14}** key again to enter exposure mode (ms display blank).

h. Insert appropriate film cassette into bucky and make an exposure.

i. Develop the film and measure density with a densitometer. **RECORD** this **Measured Density** value in **Table W–4** of the **Calibration Worksheet**.

j. If the density is between 1.2 and 1.4, proceed with step **32**, otherwise, repeat steps **a** through **i**.

30. Press the **APR_{14}** key to display the Termination Value in the ms display. RECORD this **Final Termination** value in **Table DS–1** of the **Calibration Data Sheet** for **Screen 2** at **110kV**.

31. Fill in the remaining kV values for **Screen 2** in **Table DS–1** as follows:

    a. To get the 60kV value, add the 50kV value and the 70kV value and divide by 2.

   b. To get the 80kV value, add the 70kV value and the 90kV value and divide by 2.

   c. To get the 100kV value, add the 90kV value and the 110kV value and divide by 2.

   d. For the 120kV and 130kV values, copy the 110kV value.

NOTE

Even though maximum kV is 125, a value must be defined for 130kV for interpolation purposes.

32. If necessary, press the **APR$_{14}$** key so that the termination value is displayed in the ms display.

33. Enter the data from the table as follows:

   a. Using the **mAs +** and **mAs -** keys, select the desired kV value.

   b. Press the **APR$_{13}$** key to enter data entry mode (indicators adjacent to **APR$_{1}$** through **APR$_{10}$** illuminated).

   c. Using the appropriate APR keys (**APR$_{1}$** through **APR$_{10}$**), enter the termination value as defined in **Table DS–1**.

   d. Press the **APR$_{14}$** key to accept the value (indicators adjacent to **APR$_{1}$** through **APR$_{10}$** extinguished).

NOTE

If a mistake is made on entry, after pressing **APR$_{14}$** to accept, press **APR$_{13}$** to re-enter data entry mode, then enter the correct number and press **APR$_{14}$** to accept.

   e. Repeat steps **a** through **d** for each kV value in **Table DS–1**.

Calibration of Other Screen Keys

Normally, only the middle screen key (**Screen 2**) is calibrated for the most commonly used film/screen combination. However, if other screen types will be used with the system, the other screen keys (**Screen 1** and **Screen 3**) may be calibrated to match the other screen characteristics.

If only one screen will be used, it is best to enter the same calibration values for **Screen 1** and **Screen 3** as were entered for **Screen 2**. If other screens are to be used, **Screen 1** should be set for the highest speed and **Screen 3** should be set for the lowest. Refer to **Table 3–8**.

CAUTION

THE SETTING OF POTENTIOMETER R106 ON THE CPU PCB MUST NOT BE CHANGED.

1. Place at least 10 cm of absorber in the center of the x-ray field.
2. Enter service mode. Refer to **Entering Service Mode** in **Service Mode General Information**.
3. If it is not already on, turn on AEC (indicator illuminated).

NOTE

If calibrating more than one screen, calibrate the slowest screen first.

4. Using the control panel keys, select small focus, center field and the desired screen (normally **Screen 2**).

NOTE

As long as the screen key is depressed the programmed film/screen speed is displayed in the **ms** display.

5. Verify that the expected screen speed is displayed. If not, make changes in accordance with **Table 3–8**.
6. Select backup mAs using the **mAs +** and **mAs -** keys (320 mAs is recommended).
7. On the control panel, press the **APR5** key.
8. If necessary, using the **kV +** and **kV -** keys, select Default Exposure Termination. The number **4** will appear in the **kV** display.
9. If necessary, set to 50 kV using the **mAs +** and **mAs -** keys. The kV value is displayed in the **mAs** display.

10. An initial Termination Value (shown in the ms display) must be set. Set the Termination Value to an appropriate value as shown in **Table 3–9**.

TABLE 3–9 SCREEN SPEED TERMINATION VALUES

Screen/Film Speed	Initial Termination Value
Greater than 400	2500
200 to 400	5000
Less than 200	7500

11. Press **APR$_{13}$** to enter data entry mode (indicators adjacent to **APR$_1$** through **APR$_{10}$** illuminated).

12. Enter the Termination Value using the appropriate APR keys (**APR$_1$** through **APR$_{10}$**).

13. Press the **APR$_{14}$** key to accept the value (indicators adjacent to **APR$_1$** through **APR$_{10}$** extinguished).

14. Perform steps **13** through **35** of the paragraph entitled **Calibration of First Screen** for both **Screen 1** and **Screen 3**.

ADJUSTMENT OF AEC CALIBRATION

The procedures defined in the paragraph entitled **Phototimer (AEC) Calibration (APR$_5$)** describe how to fully calibrate the AEC screen keys for the first time. However, once completed, experience may show that certain kV ranges produce consistently light or dark films. Adjustments may be made to only the kV range in question without affecting other settings.

For example, if AEC films are consistently light around 80kV for **Screen 2**, the following procedure may be used to improve AEC results in this range:

1. Enter service mode. Refer to **Entering Service Mode** in **Service Mode General Information**.

2. If it is not already on, turn on AEC (indicator illuminated).

3. Select the desired screen key (**Screen 2** in this example) by pressing the appropriate screen key on the Control Panel.

4. Press the **APR$_5$** key.

5. if necessary, use the **kV +** and **kV -** keys to select the Default Exposure Termination sub-function (the number **4** appears in the kV display).

6. Using the **mAs +** and **mAs -** keys, select the desired kV (80kV in the example).

7. Note the Termination Value displayed in the ms display window. If darker films are required, this value must increase (20% is a good starting point). If lighter films are required, this value must decrease.

8. Press the **APR$_{13}$** key to enter data entry mode (indicators adjacent to **APR$_{1}$** through **APR$_{10}$** illuminated).

9. Using the appropriate APR keys (**APR$_{1}$** through **APR$_{10}$**), enter the **New Termination** value.

10. Press the **APR$_{14}$** key to accept the value (indicators adjacent to **APR$_{1}$** through **APR$_{10}$** extinguished).

NOTE

If a mistake is made on entry, after pressing **APR$_{14}$** to accept, press **APR$_{13}$** to re-enter data entry mode, then enter the correct number and press **APR$_{14}$** to accept.

11. Press the **APR$_{14}$** key again to exit the AEC test mode.

12. Press the **BUT** key to exit the service mode.

13. Make a test film at the desired kV to verify correct density. If required, repeat steps **1** through **12** at all kV values for which improvement is desired.

FAULT DIAGNOSTICS (APR$_{6}$)

The **Fault Diagnostics** selection in the main function group is used to display exposure counters and error memory management. The use of the **Fault diagnostics** is provided in the section entitled **DIAGNOSTICS** in this manual.

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CLINIX VP4 GENERATOR CALIBRATION WORKSHEET

TABLE W–1 PRELIMINARY DENSITY ADJUSTMENT

Exposure Number	kV	Measured Density
1	50	
2		
3		
4		
5		
6		

TABLE W–2 TERMINATION VALUE AT 70KV

Measured Density	Target Density	Ratio	Termination Value	
			Old	New
	1.30			

CLINIX VP4 GENERATOR CALIBRATION WORKSHEET (CONTINUED)

TABLE W–3 TERMINATION VALUE AT 90KV

Measured Density	Target Density	Ratio	Termination Value	
			Old	New
	1.30			

TABLE W–4 TERMINATION VALUE AT 110KV

Measured Density	Target Density	Ratio	Termination Value	
			Old	New
	1.30			

CLINIX VP4 GENERATOR CALIBRATION DATA SHEET

TABLE DS–1 FINAL TERMINATION VALUES

kV	Termination Value		
	Screen 2	Screen 1	Screen 3
40	7500		
50	7500		
60			
70			
80			
90			
100			
110			
120			
130			

PLANNED MAINTENANCE

INTRODUCTION

The purpose of this section is to provide service personnel with scheduled maintenance that should be performed to ensure adequate operation of the Clinix VP4 Generator.

This section contains procedures which when performed at the time intervals specified, will assure continued compliance with the Manufacturer's Equipment Specifications in effect at time of shipment.

WARNING

HIGH VOLTAGES ARE PRESENT IN THE SYNERGEN GENERATOR. OBSERVE ALL PRECAUTIONS FOR WORKING ON HIGH VOLTAGE EQUIPMENT WHEN SERVICING THE SYNERGEN GENERATOR. FAILURE TO COMPLY MAY CAUSE SERIOUS OR FATAL INJURIES TO SERVICE PERSONNEL.

SPECIAL TOOLS AND EQUIPMENT

The following special tools and calibrated test equipment or its equivalent is required to perform selected procedures contained in this section:

1. Standard service tool kit.

SAFETY INFORMATION

Service personnel are cautioned to observe all CAUTIONS and WARNINGS as they appear in the text of this section. Failure to comply may result in bodily injury to service personnel.

MAINTENANCE SCHEDULE

Service personnel are required to perform certain maintenance procedures at regular intervals. The maintenance schedule is provided in **Table 4–1**. The table includes the maintenance item, the periodicity of the maintenance, and the instructions or a reference to the instructions required for performing the maintenance.

TABLE 4–1 MAINTENANCE SCHEDULE

Maintenance Item	Time Interval	Instructions
External Visual Checks	6 months	1. Check control panel for nicks, scratches, and/or dents. 2. Ensure proper seating of APR labels. 3. Inspect unit for all warning labels, serial tags, UL, and CSA tags.
Mechanical Checks	6 months	Refer to **Mechanical Checks** paragraph in this section.
Operational Checks	6 months	Refer to **Operational Checks** paragraph in this section.
Regrease High-Tension Cables	12 months	Refer to **Greasing High-Tension Cables** paragraph in this section.
Replace NVRAM	72 months	Refer to **NVRAM Replacement** paragraph in this section.
Final Appearance Checks	6 months	1. Clean all exposed exterior surfaces of the generator using isopropyl alcohol. 2. Ensure that all mounting hardware is secure and that all covers are in place.

MAINTENANCE PROCEDURES

MECHANICAL CHECKS

For the mechanical checks portion of preventive maintenance, power should be removed from the Clinix VP4 Generator system. Mechanical Checks include external visual checks and final appearance checks. The sequence of the Mechanical Checks is defined in **Table 4–2**.

TABLE 4–2 MECHANICAL CHECKS

No.	Freq. (mos.)	Check/Test	Equipment Required	Test Conditions	Test Points (+,-)	Tol.	Adj.	Test Ref.
1		**External Visual Checks**		Power Off				
1.1	6	Check control panel stand, if so equipped for nicks, scratches, or dents.	None					
1.2	6	Check for proper seating of APR labels.	None					
1.3	6	Inspect unit for all warning labels, serial tags, UL and CSA tags.	None					
2		**Mechanical Checks**		Power Off				
2.1	6	Check mechanical operation of control panel on/off and prep/expose switches.	None					
2.2	6	Remove H.T. cables from transformer ports and check for proper level of oil. Check that H.T. cables are securely tightened.	None					
2.3	6	Check connections on all cables on top of H.T. transformer.	None					
2.4	6	Check connections on all cables in electronincs cabinet.	None					
2.5	6	Check connections on all cables in operator control panel.	None					

OPERATIONAL CHECKS

For the operational checks portion of preventive maintenance, power will need to be applied to the Clinix VP4 Generator system. The sequence of the Operational Checks is defined in **Table 4–3**.

TABLE 4–3 OPERATIONAL CHECKS

No.	Freq. (mos.)	Check/Test	Equipment Required	Test Conditions	Test Points (+,-)	Tol.	Adj.	Test Ref.
1		**Operational Checks**		Power On				
1.1	6	Check for proper power-up sequence.	None					
1.2	6	Check for proper operation of control panel switches; run fault diagnostics.	None					
1.3	6	Check for proper operation of control panel LEDs; run fault diagnostics.	None					
1.4	6	Check for proper operation of control panel display; run fault diagnostics.	None					
1.5	6	Check for proper operation of control panel to generator communications; run fault diagnostics.	None					
1.6	6	Check +5V power supply	None		+5V	±0.05V	None	Calibration Section
1.7	6	Check ±15V power supply	None		+15V, -15V	±0.3V, ±0.3V	R53, R54	Calibration Section
1.8	6	Check +24V power supply	None		+24V	±0.5V	None	Calibration Section
1.9	6	Depress PREP switch and check that control panel display reads “READY”	None	Low exposure setting				
1.10	6	Depress EXPOSURE switch and listen for audible indicator to sound and check control panel exposure indicator light.	None	Low exposure setting				
1.11	6	Check that BUT logic works - Display BUT LED should light.	None	AEC selected; field blocked				
1.12	6	Check for actual MAS indication in display.	None	AEC exposure made.				
1.13	6	Check that another AEC exposure cannot be made.	None					
1.14	6	Check that reset button resets the BUT and another exposure can be made.	None					

TABLE 4–3 OPERATIONAL CHECKS - CONTINUED

No.	Freq. (mos.)	Check/Test	Equipment Required	Test Conditions	Test Points (+,-)	Tol.	Adj.	Test Ref.
1.15	6	Check kV, mA, and time accuracy.	Scope, DVM, MAS meter		TP1/ TP2 Meas. PCB	User's State	Recal Sys.	Calibration Section
1.16	6	Check PT station(s) for proper density tracking.	Densitometer film, water phantom	AEC setup high tech factors.			AEC recal	Calibration Section
2		**Final Appearance Check**		Power off.				
2.1	6	Clean all exposed exterior surfaces of the Clinix VP4 Generator.	Isopropyl Alcohol					
2.2	6	Check that all mounting hardware is secure and all covers are in place.	Hand tools					

GREASING HIGH-TENSION CABLES

1. Loosen nut-ring securing the anode high-tension cable in place on the x-ray tube. Refer to **Figure 4–1**.

CAUTION

THE ANODE AND CATHODE CABLES ARE NOT INTERCHANGEABLE. ENSURE THAT THE CABLES ARE REINSTALLED IN THE CORRECT SOCKET, OTHERWISE, DAMAGE TO THE EQUIPMENT MAY RESULT.

2. Remove the anode high-tension cable from the x-ray tube socket.
3. Clean off all old grease from the shaft of the high-tension cable termination.
4. Grease the high-tension cable shaft.
5. Insert the shaft into the appropriate socket and secure with nut-ring.
6. Repeat steps 1 through 5 for the cathode high-tension cable connected to the x-ray tube.

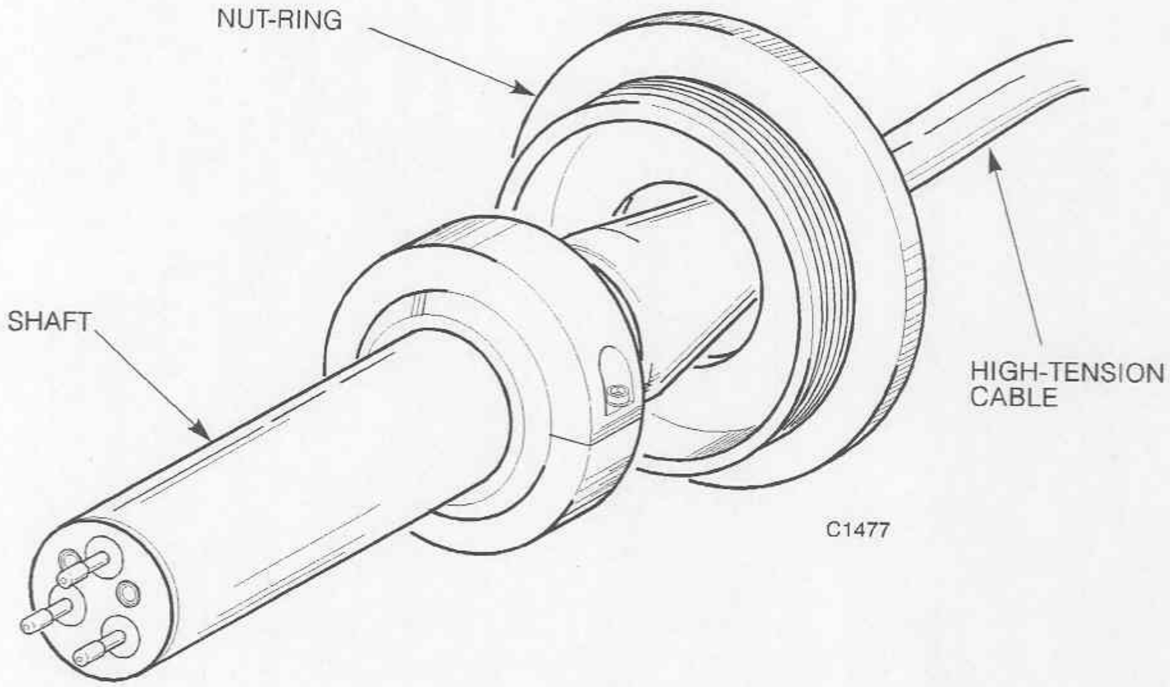


FIGURE 4–1 HIGH-TENSION CABLE TERMINATION

7. Perform the removal portion of the **Service Access** procedures defined in the section entitled **REPLACEMENT PARTS** in this manual.

8. Loosen nut-ring securing the anode high-tension cable in place in the hig-tension tank.

CAUTION

THE ANODE AND CATHODE CABLES ARE NOT INTERCHANGEABLE. ENSURE THAT THE CABLES ARE REINSTALLED IN THE CORRECT SOCKET, OTHERWISE, DAMAGE TO THE EQUIPMENT MAY RESULT.

9. Remove the anode high-tension cable from the tank socket.

10. Clean off all old grease from the shaft of the high-tension cable termination.

11. Grease the high-tension cable shaft.

12. Insert the shaft into the appropriate socket and secure with nut-ring.

13. Repeat steps 8 through 12 for the cathode high-tension cable connected to the high-tension tank.
14. Perform the installation portion of the **Service Access** procedures defined in the section entitled **REPLACEMENT PARTS** in this manual.

NVRAM REPLACEMENT

1. Perform the removal portion of the **Service Access** procedures defined in the section entitled **REPLACEMENT PARTS** in this manual.
2. Remove the NVRAM IC from its socket. Refer to **Figure 4–2**.
3. Ensuring proper orientation, install the new NVRAM IC in the socket.
4. Perform the installation portion of the **Service Access** procedures defined in the section entitled **REPLACEMENT PARTS** in this manual.

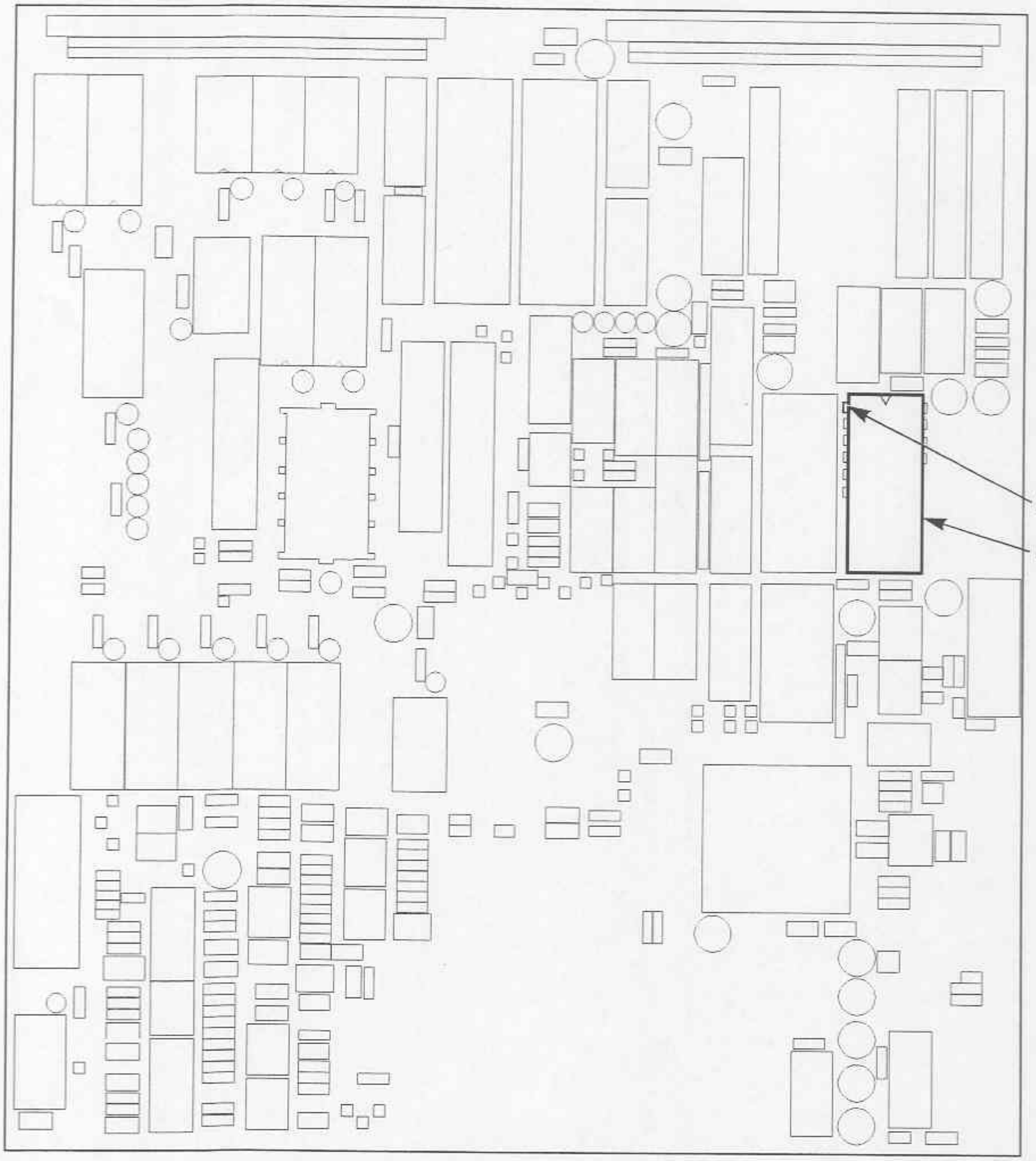

PIN 1
NVRAM IC
C1476

FIGURE 4–2 NVRAM IC LOCATION AND ORIENTATION

REPLACEMENT PARTS

INTRODUCTION

The purpose of this section is to provide service personnel with maintenance information pertaining to the replacement of certain components of the Clinix VP4 Generator.

This section contains procedures that are non-standard or that required specific instructions. Most replacement procedures are straight-forward and require no special instructions. These procedures when performed, will assure continued compliance with the Manufacturer's Equipment Specifications in effect at time of shipment.

WARNING

HIGH VOLTAGES ARE PRESENT IN THE CLINIX VP4 GENERATOR. OBSERVE ALL PRECAUTIONS FOR WORKING ON HIGH VOLTAGE EQUIPMENT WHEN SERVICING THE CLINIX VP4 GENERATOR. FAILURE TO COMPLY MAY CAUSE SERIOUS OR FATAL INJURIES TO SERVICE PERSONNEL.

SPECIAL TOOLS AND EQUIPMENT

The following special tools and calibrated test equipment or its equivalent is required to service the Clinix VP4 Generator and associated assemblies:

1. Standard service tool kit.

SAFETY INFORMATION

Service personnel are cautioned to observe all CAUTIONS and WARNINGS as they appear in the text of this section. Failure to comply may result in bodily injury to service personnel.

REPLACEMENT PROCEDURES

SERVICE ACCESS

These procedures must be performed prior to and after any procedure provided in this section, except for control panel PCB replacement.

Removal

1. Remove power from system.
2. Remove four screws and flat washers securing front cover to table and remove front cover (Refer to **Figure 5–1**).

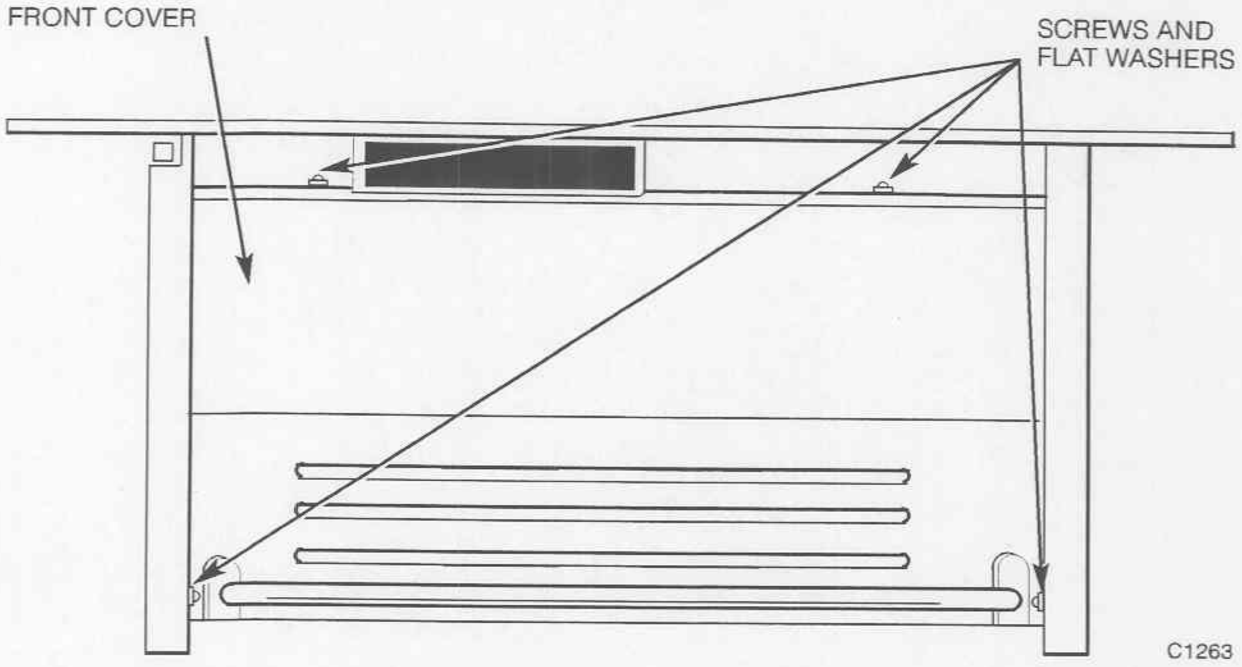


FIGURE 5–1 ACCESSING GENERATOR FOR SERVICE

3. Loosen two screws (one at each end) securing brake release pedal and slide pedal out of pedal blocks (Refer to **Figure 5–2**).

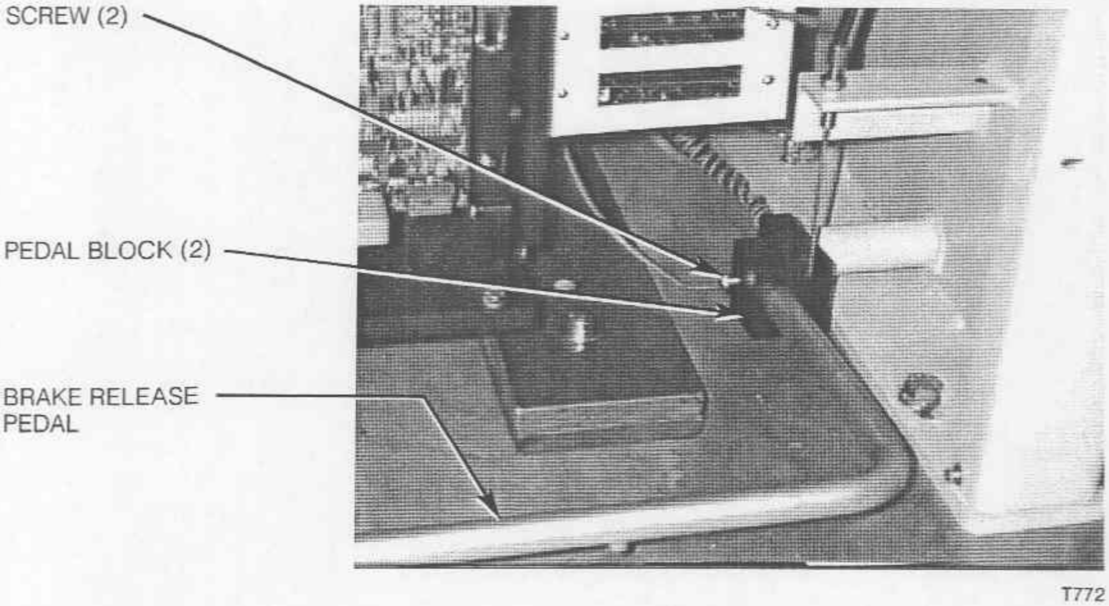


FIGURE 5–2 PEDAL ASSEMBLY

4. Remove two screws and washers securing generator assembly holding bracket to mounting plate (Refer to **Figure 5–3**).

5. Carefully roll generator assembly out from under table.

6. The generator assembly is now ready for maintenance.

Installation

1. Carefully roll generator assembly under table.

2. Secure generator assembly to mounting plate using two screws and washers (Refer to **Figure 5–3**).

3. Install brake release pedal into pedal blocks and secure in place by tightening two screws (Refer to **Figure 5–2**).

4. Position table front cover to table and secure in place using four screws and flat washers (Refer to **Figure 5–1**).

5. The system is now ready for operation.

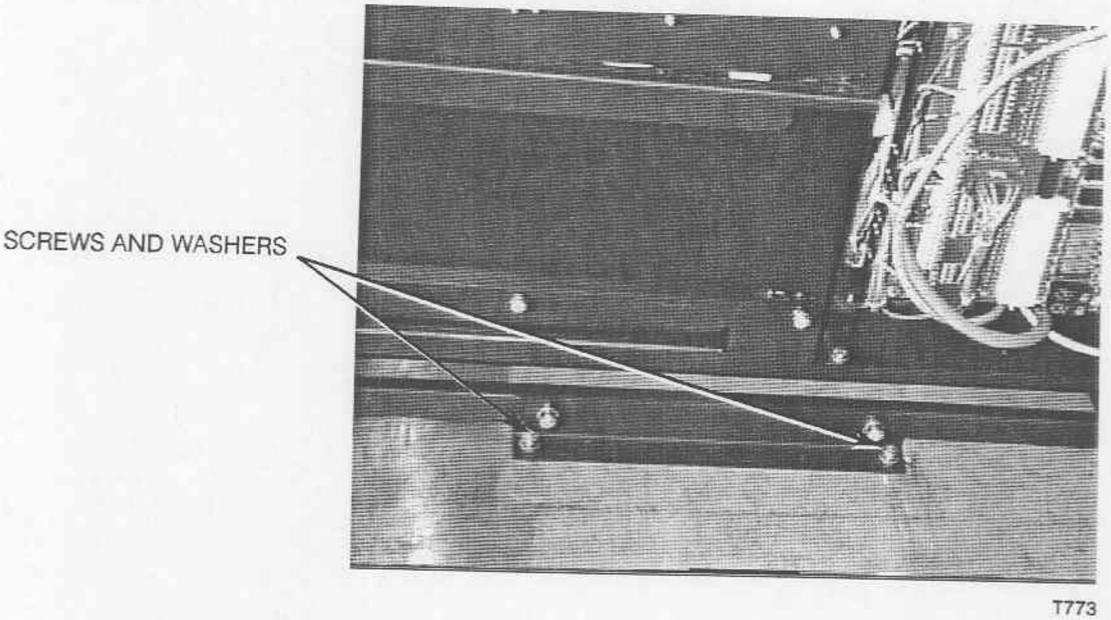


FIGURE 5–3 GENERATOR ASSEMBLY

CENTRAL UNIT PCB REPLACEMENT

1. Disconnect all cables connected to the Central Unit PCB.
2. Remove Central Unit PCB from door of electronics chassis by pulling PCB off of the mounting posts and disconnecting from edge connectors.
3. There are 27 jumpers located in various positions on the Central Unit PCB. Compare jumper settings of replacement PCB with existing PCB and reconfigure jumpers as necessary. Refer to **Figure 5–4** for jumper locations.
4. Engage Central Unit PCB into edge connectors on door of electronics chassis and press onto mounting posts.
5. Connect all cables to replacement Central Unit PCB that were disconnected from original Central Unit PCB.

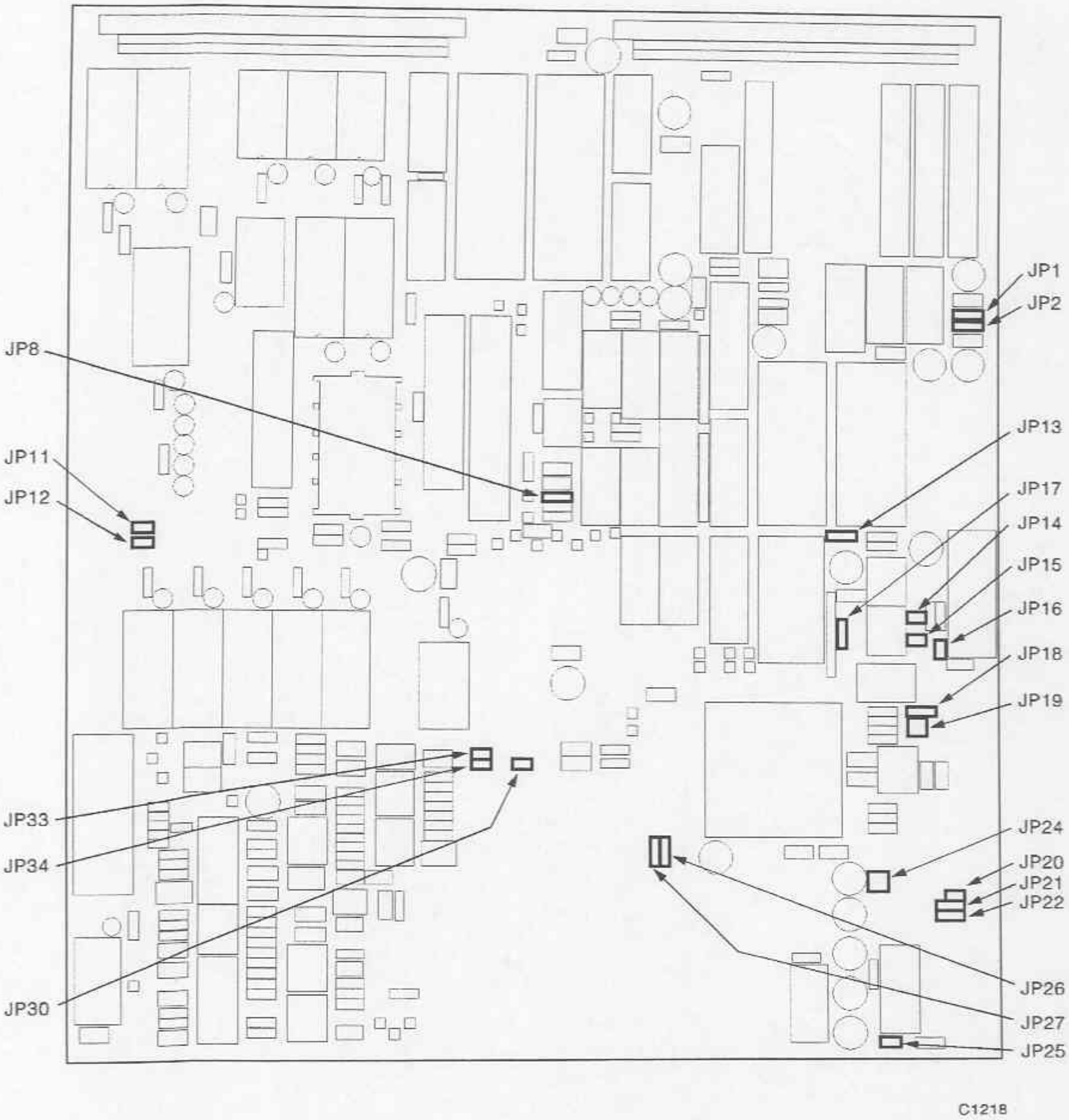

JP1
JP2
JP8
JP11
JP12
JP13
JP17
JP14
JP15
JP16
JP18
JP19
JP33
JP34
JP24
JP20
JP21
JP22
JP30
JP26
JP27
JP25
C1218

FIGURE 5–4 CENTRAL UNIT PCB JUMPER LOCATIONS

CAUTION

DO NOT CORRECT THESE VOLTAGES UNLESS THE MEASURING ACCURACY OF THE TEST INSTRUMENT IS ± 0.5% OR BETTER. OTHERWISE, THE VOLTAGES MAY BE IMPROPERLY SET, CAUSING IMPROPER FUNCTIONING OF THE GENERATOR.

6. Apply 220 power to the system.
7. At the control panel, apply power to the generator.
8. Measure voltages U1 through U3 on the power supply PCB at the test points listed in **Table 5–1** and adjust as necessary.

TABLE 5–1 POWER SUPPLY VOLTAGES

Measurement Point	Voltage Requirements	Correction	Indicator	Test Points	
				From	To
U1	+5.0 ± 0.2	—	CR31	TP29 (+5 V)	TP30 (0 V)
U2	+15.0 ± 0.3	R53	CR41	TP31 (+15 V)	TP32 (0 V)
U3	-15.0 ± 0.3	R54	CR44	TP34 (-15 V)	TP33 (0 V)

9. Component locations are provided in **Figure 5–5**.
10. Measure voltage U4 (24Vdc) at the 24Vdc test jack on the line relay chassis.
11. The AEC Unit must be recalibrated accordingly (potentiometers R105 and R106).

CONTROL PANEL PCB REPLACEMENT

1. Disconnect RS232 cable from connector B1 of control panel PCB.
2. Before replacing the control panel PCB, check whether the 24Vdc operating voltage is present at the end of the RS232 cable (pin 9 to pin 5).
3. Disconnect three ribbon cable connectors connected to control panel PCB.

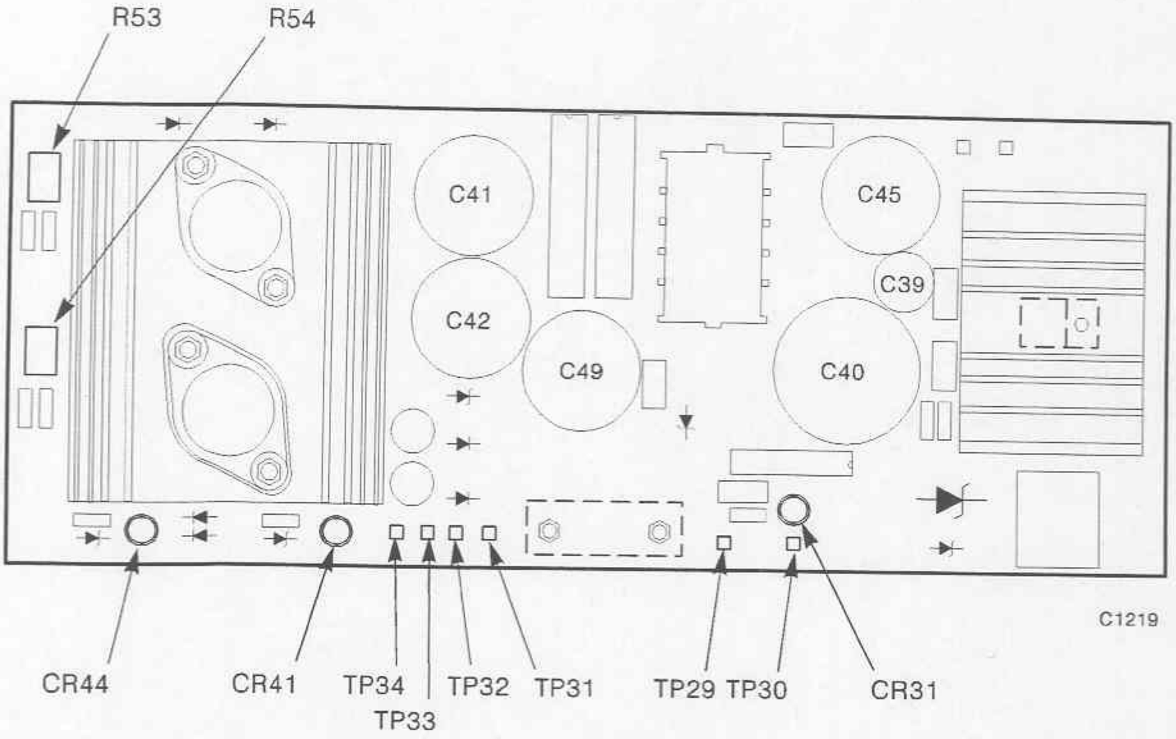


FIGURE 5–5 POWER SUPPLY PCB TEST POINTS

CAUTION

DO NOT BEND THE CABLES MORE THAN NECESSARY FOR REPLACEMENT. OTHERWISE DAMAGE TO THE CABLES MAY RESULT.

4. The jumper positions of the new control panel PCB must be compared with the old unit and corrected as required. For jumper locations, refer to **Figure 5–6**.

5. Remove six (6) nuts securing defective control panel PCB to control panel.

6. Position replacement PCB to control panel and secure in place using six (6) nuts.

7. Adjustments are available for brightness of the control panel numeric displays and LED indicators. There also is adjustment available for the exposure alert volume. Using the procedure that follows, make adjustments to preference.

   a. Ensure generator power is ON and system is operational.

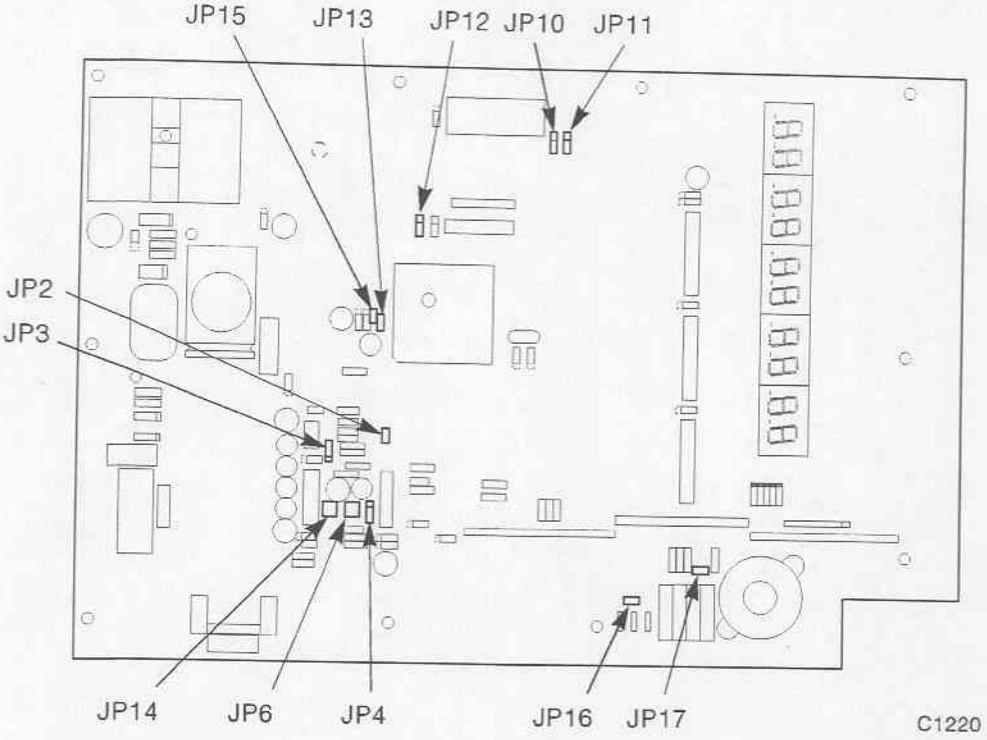


FIGURE 5–6 CONTROL PANEL PCB JUMPER POSITIONS

b. Open control panel to gain access to control panel PCB.

c. Adjust numeric display brightness using potentiometer R21. For component locations, refer to **Figure 5–7**.

d. Adjust LED indicator brightness using potentiometer R25.

e. Adjust exposure alert volume using potentiometer R19.

f. Close control panel.

INVERTER CHASSIS REPLACEMENT

1. Remove the high-tension cables at the anode and cathode connections on the high-tension transformer.
2. Remove leads from brass bolts P1 and P2.
3. Disconnect connector P91 from the high-tension transformer.
4. Disconnect wiring harness connection P10/J10.

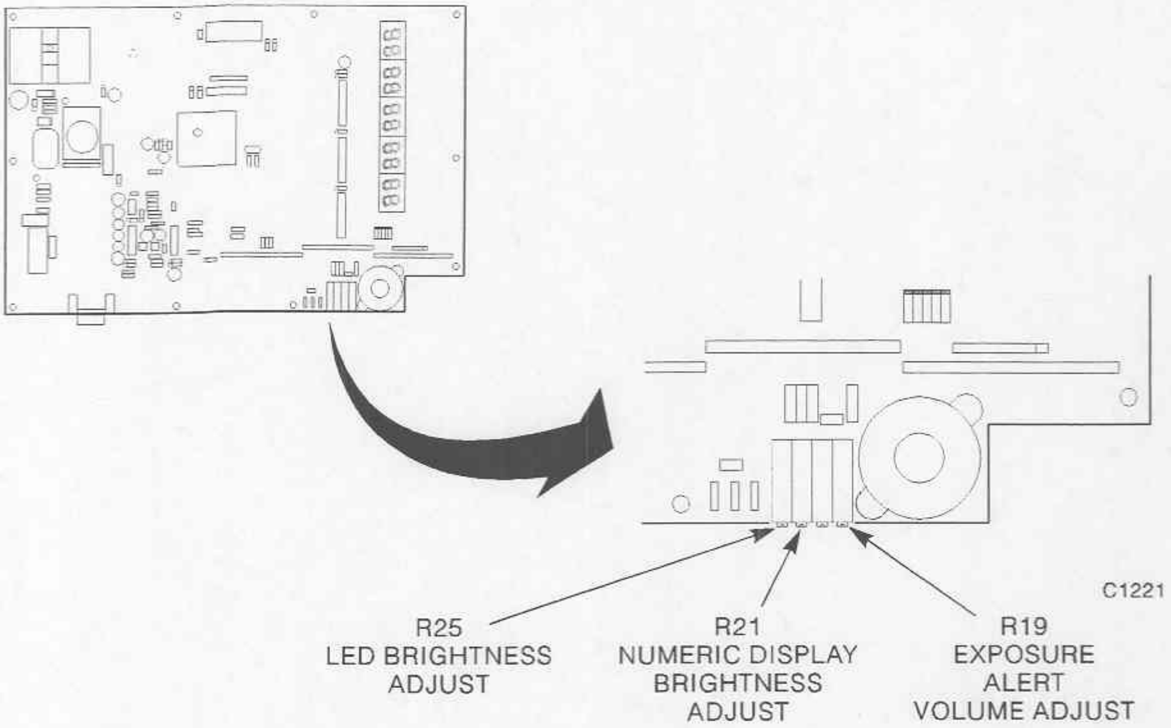

C1221
R25
LED BRIGHTNESS
ADJUST
R21
NUMERIC DISPLAY
BRIGHTNESS
ADJUST
R19
EXPOSURE
ALERT
VOLUME ADJUST

FIGURE 5–7 CONTROL PANEL ADJUSTMENTS

5. Disconnect ribbon cable between Filament Drive and Central Unit PCBs at Filament Drive PCB connector J35.
6. Disconnect ribbon connector between mA/IVC PCB and Central Unit PCBs at mA/IVC PCB connector J51.
7. At rectifiers CR01 and CR03, label and remove leads from line chassis.
8. Loosen grounding bolt hex nut and remove ground connectors.
9. Remove four hex nuts securing inverter chassis to high-tension transformer located at the corners of the inverter chassis.
10. Remove inverter chassis and install replacement.
11. Secure inverter chassis to high-tension transformer using four hex nuts.
12. Install ground connectors on grounding bolt and secure with hex nut.
13. Connect leads from the line chassis to rectifiers CR01 and CR03.

14. Connect ribbon cable from Central Unit PCB connector J50 to mA/IVC PCB connector J51.
15. Connect ribbon cable from Central Unit PCB connector J30 to Filament Drive PCB connector J35.
16. Connect wiring harness connection P10/J10.
17. Connect P91 connector to the high-tension transformer.
18. Connect leads to brass bolts P1 and P2.
19. Connect high-tension cables to the appropriate anode and cathode connections on the high-tension transformer.

HIGH-TENSION TRANSFORMER REPLACEMENT

1. Remove the high-tension cables at the anode and cathode connections on the high-tension transformer.
2. Remove leads from brass bolts P1 and P2.
3. Disconnect connector P91 from the high-tension transformer.
4. Disconnect wiring harness connection P10/J10.
5. Disconnect ribbon cable between Filament Drive and Central Unit PCBs at Filament Drive PCB connector J35.
6. Disconnect ribbon connector between mA/IVC PCB and Central Unit PCBs at mA/IVC PCB connector J51.
7. At rectifiers CR01 and CR03, remove leads to line chassis.
8. Loosen grounding bolt hex nut and remove ground connectors.
9. Remove four hex nuts securing inverter chassis to high-tension transformer located at the corners of the inverter chassis.
10. Remove inverter chassis.
11. Position replacement high-tension transformer in front of generator assembly.

12. Position inverter chassis to high-tension transformer and secure with four hex nuts.

13. Install ground connectors on grounding bolt and secure with hex nut.

14. Connect leads from the line chassis to rectifiers CR01 and CR03.

15. Connect ribbon cable from Central Unit PCB connector J50 to mA/IVC PCB connector J51.

16. Connect ribbon cable from Central Unit PCB connector J30 to Filament Drive PCB connector J35.

17. Connect wiring harness connection P10/J10.

18. Connect P91 connector to the high-tension transformer.

19. Connect leads to brass bolts P1 and P2.

20. Connect high-tension cables to the appropriate anode and cathode connections on the high-tension transformer.

ELECTRONICS CHASSIS REPLACEMENT

1. Disconnect ribbon cable between Filament Drive and Central Unit PCBs at Filament Drive PCB connector J35.

2. Disconnect ribbon connector between mA/IVC PCB and Central Unit PCBs at mA/IVC PCB connector J51.

3. Disconnect wiring harness connection P10/J10.

4. Loosen grounding bolt hex nut and remove ground connectors.

5. Disconnect cable connection to inverter chassis at relay K02.

6. Remove leads from line terminal strip to fuses F01 and F03.

CAUTION

ELECTRONICS CHASSIS IS HEAVY. WHEN SCREWS ARE REMOVED, ELECTRONICS CHASSIS IS NO LONGER ATTACHED TO GENERATOR ASSEMBLY. THEREFORE, USE CARE WHEN REMOVING CHASSIS. FAILURE TO COMPLY COULD RESULT IN INJURY TO SERVICE PERSONNEL.

7. Remove four (4) screws and lock washers securing electronics chassis to generator assembly and remove electronics chassis.
8. Position replacement electronics chassis to generator assembly and secure in place using four (4) screws and lock washers.
9. Connect leads from line terminal strip to fuses F01 and F03.
10. Connect inverter chassis leads to relay K02.
11. Install ground connectors on grounding bolt and secure with hex nut.
12. Perform calibration procedures.

MA/IVC PCB REPLACEMENT

1. Normally the mA/IVC PCB can be replaced without adjustment. However, prior to use, the following checks should be performed:
   a. At the control panel select a 100 kV exposure.
   b. Measure the voltage at test point TP11 on the mA/IVC PCB. Component locations are provided in **Figure 5–8**.
   c. If necessary, adjust potentiometer R121 for 5 (±0.5)Vdc.
   d. Measure the high voltage and, if necessary, adjust using potentiometer R127.

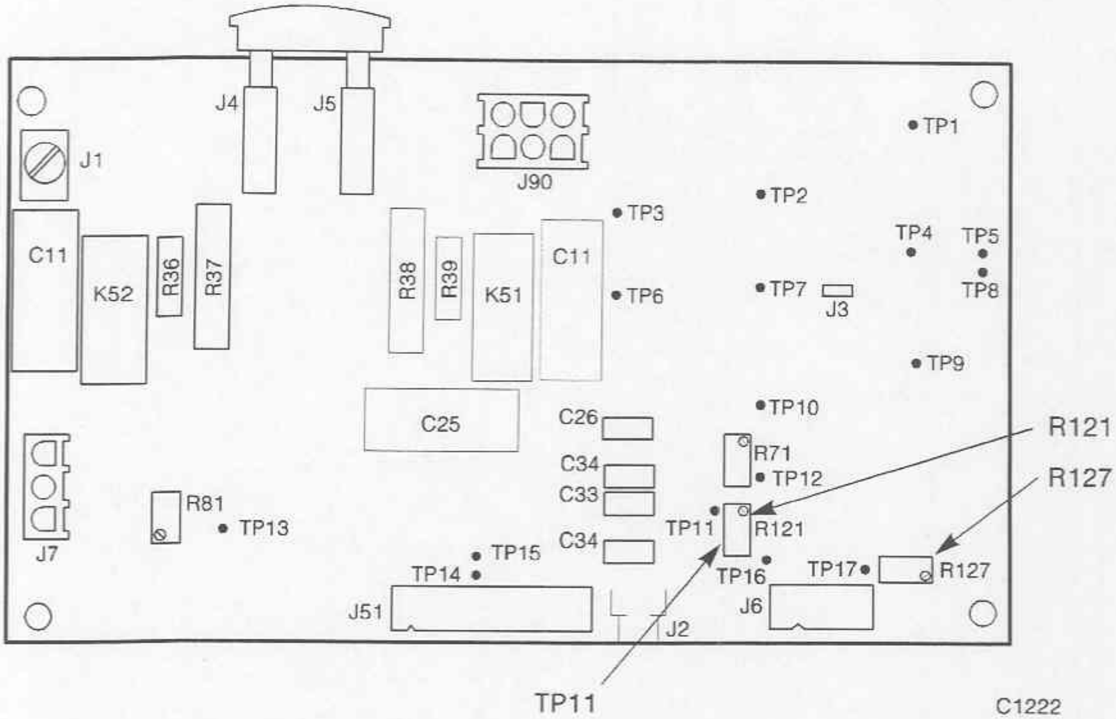

J4
J5
J1
J90
TP1
TP2
TP3
C11
K52
R36
R37
R38
R39
K51
C11
TP6
TP7
J3
TP4
TP5
TP8
TP9
TP10
C25
C26
R71
TP12
R121
R127
C34
C33
C34
J7
R81
TP13
TP15
TP14
TP11
R121
TP16
TP17
R127
J51
J2
J6
TP11
C1222

FIGURE 5–8   MA/IVC PCB COMPONENT LOCATIONS

TROUBLESHOOTING

INTRODUCTION

The purpose of this section is to provide service personnel with troubleshooting information for the Clinix VP4 Generator system. This section includes troubleshooting for the components of the Clinix VP4 Generator only. For troubleshooting information pertaining to other components of the x-ray system refer to the appropriate manual(s).

The information contained in this section assumes that the maintainer is familiar with the Clinix VP4 Generator system. It is not intended to provide a remedy for every possible malfunction. It is intended to provide basic troubleshooting information to guide service personnel toward the recovery of system malfunctions. In most cases, this troubleshooting information will only be an aid to the experience of the service engineer.

SPECIAL TOOLS AND EQUIPMENT

There are no special tools and/or equipment required to perform the procedures contained in this section. Any special tools and equipment required for a procedure referenced in this section will be listed in the referenced section.

SAFETY INFORMATION

Service personnel are cautioned to observe all CAUTIONS and WARNINGS as they appear in the text of this section. Failure to comply may result in bodily injury to service personnel.

TROUBLESHOOTING

Troubleshooting of the Clinix VP4 Generator is accomplished by way of internal system error messages or specific faults that occurr. Normally, troubleshooting and recovery will be accomplished using the error codes and corresponding corrective action contained in the section of this manual entitled **Error Messages**. A general approach to troubleshooting the Clinix VP4 Generator is provided in **Figure 6–1**.

At times, the error table will refer service personnel to the troubleshooting flowcharts provided in this section. If an error message is not available, refer to the symptom list provided in **Table 6–1**. This table will also either provide a corrective action or refer service personnel to the applicable flowchart(s). If no specific symptom is found, begin

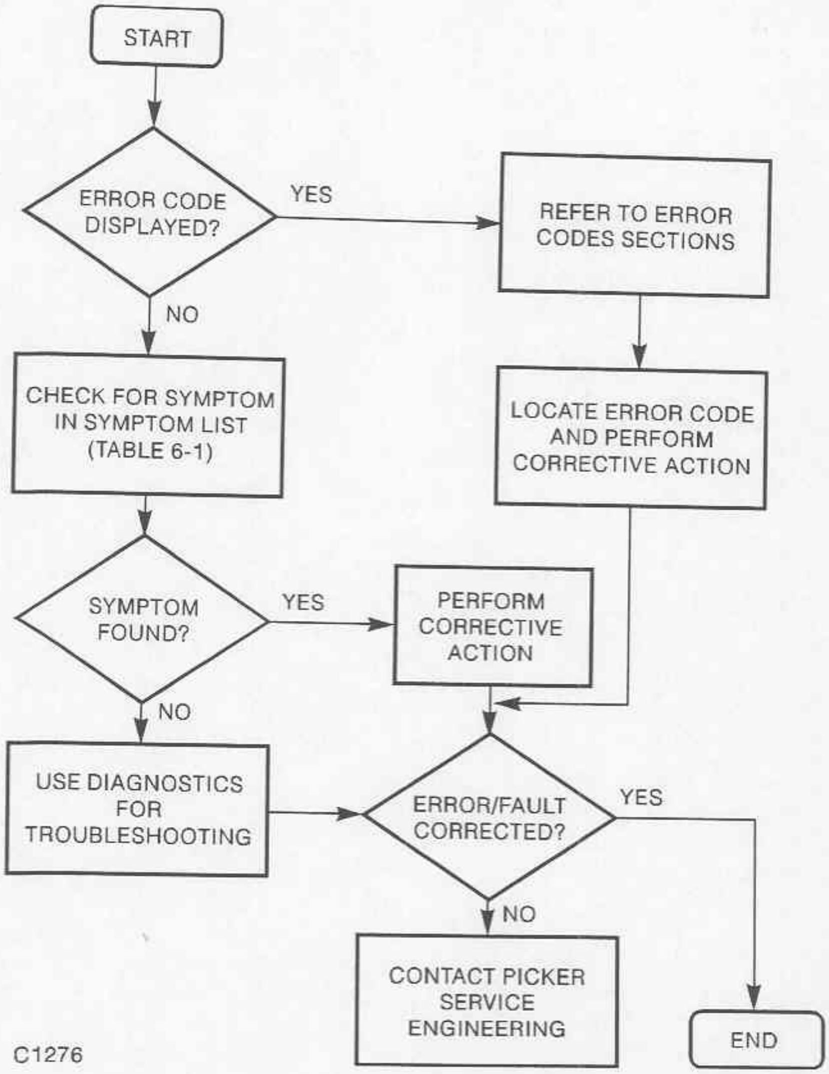

START
ERROR CODE DISPLAYED?
YES
REFER TO ERROR CODES SECTIONS
NO
CHECK FOR SYMPTOM IN SYMPTOM LIST (TABLE 6-1)
LOCATE ERROR CODE AND PERFORM CORRECTIVE ACTION
SYMPTOM FOUND?
YES
PERFORM CORRECTIVE ACTION
NO
USE DIAGNOSTICS FOR TROUBLESHOOTING
ERROR/FAULT CORRECTED?
YES
NO
CONTACT PICKER SERVICE ENGINEERING
END
C1276

FIGURE 6–1 GENERAL APPROACH TO TROUBLESHOOTING

troubleshooting with the first flowchart in the paragraph entitled **Troubleshooting Flowcharts**.

TABLE 6–1 CLINIX VP4 GENERATOR SYMPTOMS LIST

Symptom	Possible Cause	Corrective Action
No display at power on.	1. Serial Communications failure. 2. Power supply failure.	1. Refer to **Figure 6–3**. 2. Refer to **Figure 6–2**.
No exposure when exposure switch pressed.	1. Inverter failure. 2. kV watchdog termination.	1. Refer to **Figure 6–6**. 2. Refer to **Figure 6–11**.
Improper exposure (film too light/dark)	Problem may be in pickup or backup timer.	Refer to **Figure 6–15**.

TROUBLESHOOTING FLOWCHARTS

This paragraph contains the information necessary, in flowchart form, to identify and recover from virtually all malfunctions associated with the Clinix VP4 generator.

If the flowcharts do not lead to a specific recovery, or the malfunction is not adequately determined to provide a remedy, the expertise of the maintainer combined with the information provided in the **Troubleshooting**, **Diagnostics** and **Error Messages** sections, must be relied upon to resolve the error or malfunction.

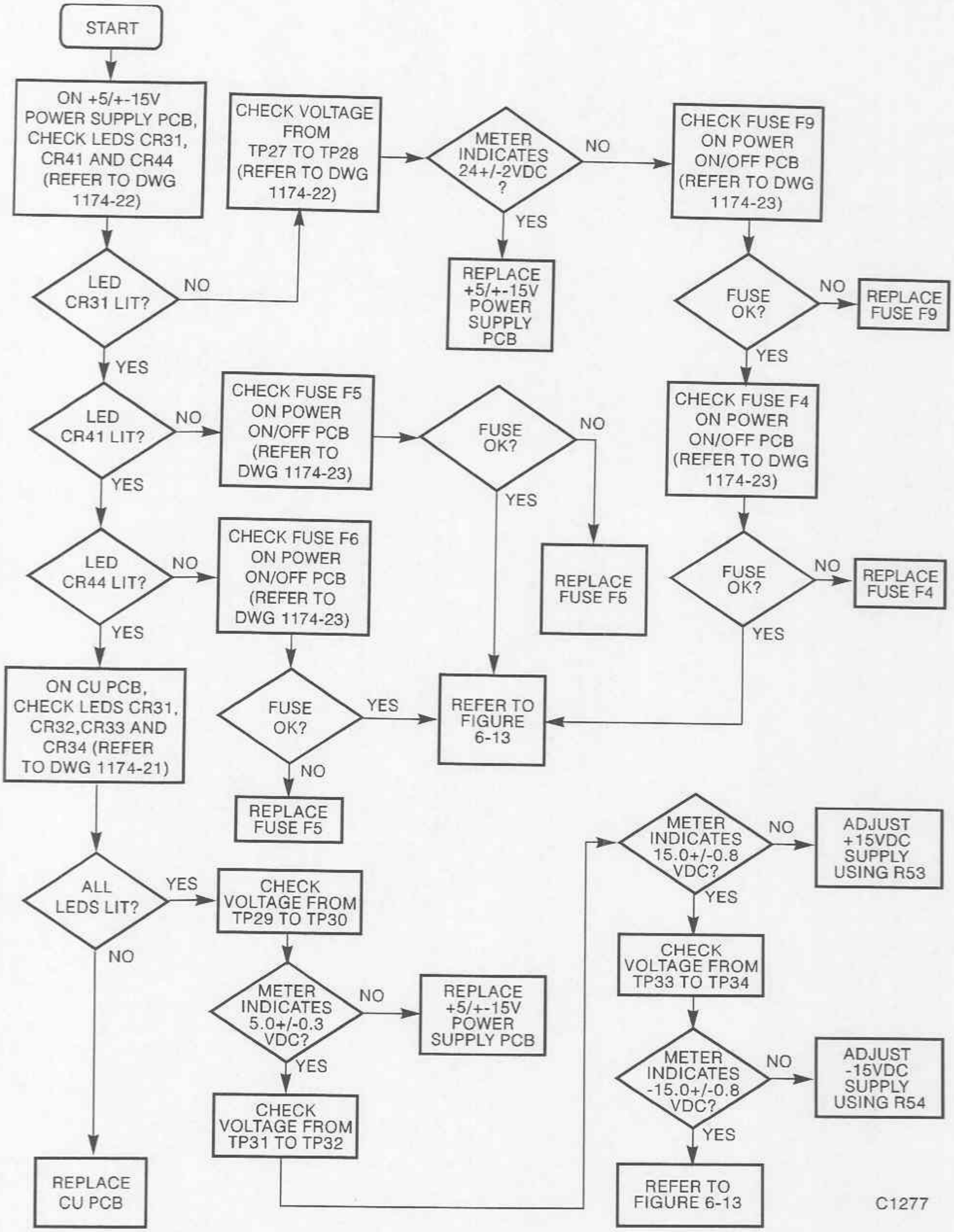

START
ON +5/+-15V POWER SUPPLY PCB, CHECK LEDS CR31, CR41 AND CR44 (REFER TO DWG 1174-22)
CHECK VOLTAGE FROM TP27 TO TP28 (REFER TO DWG 1174-22)
METER INDICATES 24+/-2VDC ?
NO
YES
CHECK FUSE F9 ON POWER ON/OFF PCB (REFER TO DWG 1174-23)
REPLACE +5/+-15V POWER SUPPLY PCB
LED CR31 LIT?
NO
YES
FUSE OK?
NO
REPLACE FUSE F9
YES
LED CR41 LIT?
NO
YES
CHECK FUSE F5 ON POWER ON/OFF PCB (REFER TO DWG 1174-23)
FUSE OK?
NO
YES
CHECK FUSE F4 ON POWER ON/OFF PCB (REFER TO DWG 1174-23)
LED CR44 LIT?
NO
YES
CHECK FUSE F6 ON POWER ON/OFF PCB (REFER TO DWG 1174-23)
REPLACE FUSE F5
FUSE OK?
NO
REPLACE FUSE F4
YES
ON CU PCB, CHECK LEDS CR31, CR32,CR33 AND CR34 (REFER TO DWG 1174-21)
FUSE OK?
YES
NO
REFER TO FIGURE 6-13
REPLACE FUSE F5
METER INDICATES 15.0+/-0.8 VDC?
NO
YES
ADJUST +15VDC SUPPLY USING R53
ALL LEDS LIT?
YES
NO
CHECK VOLTAGE FROM TP29 TO TP30
CHECK VOLTAGE FROM TP33 TO TP34
METER INDICATES 5.0+/-0.3 VDC?
NO
YES
REPLACE +5/+-15V POWER SUPPLY PCB
METER INDICATES -15.0+/-0.8 VDC?
NO
YES
ADJUST -15VDC SUPPLY USING R54
CHECK VOLTAGE FROM TP31 TO TP32
REPLACE CU PCB
REFER TO FIGURE 6-13
C1277

FIGURE 6–2 LOW VOLTAGE TROUBLESHOOTING

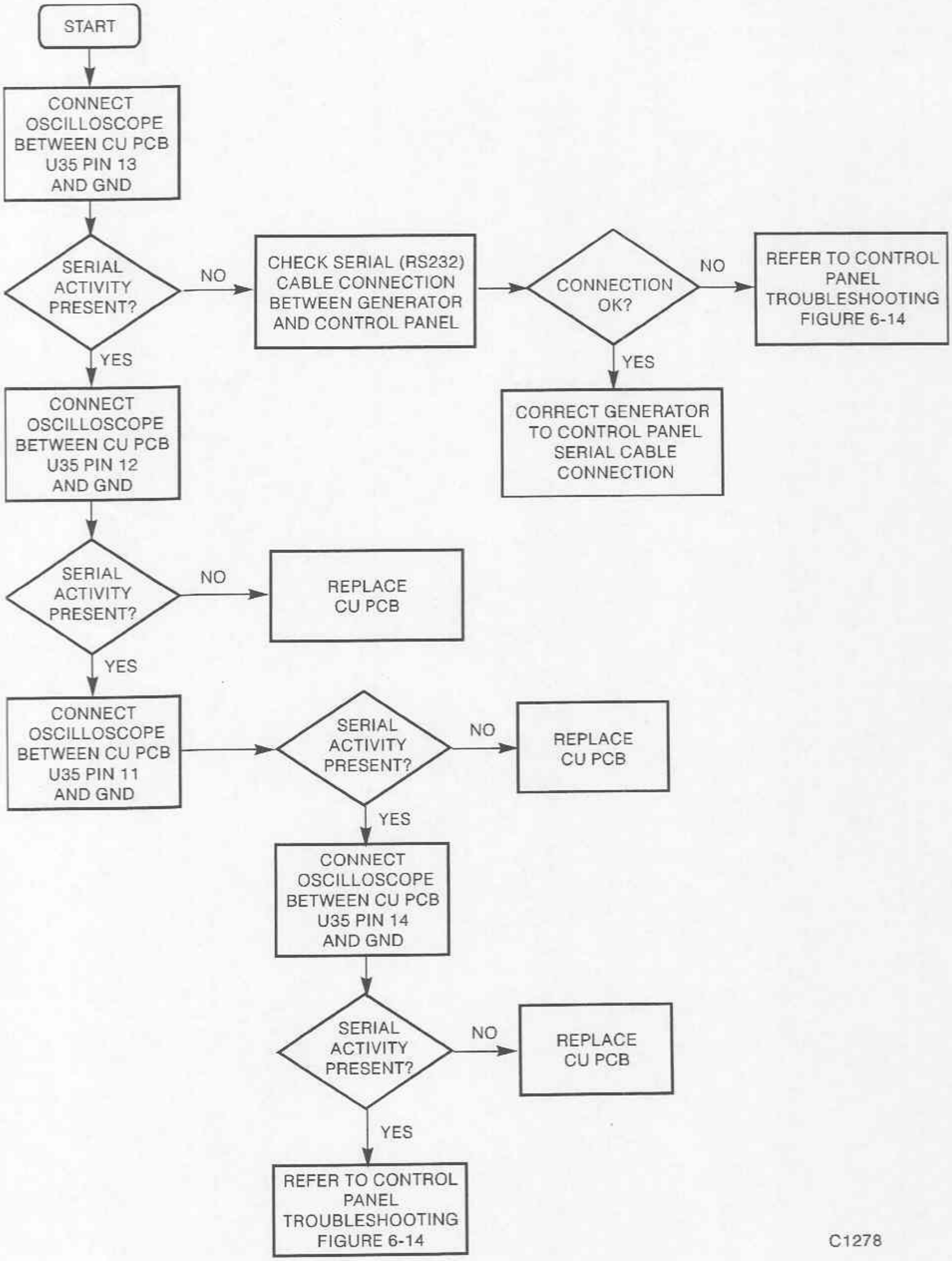

START
CONNECT OSCILLOSCOPE BETWEEN CU PCB U35 PIN 13 AND GND
SERIAL ACTIVITY PRESENT?
NO
CHECK SERIAL (RS232) CABLE CONNECTION BETWEEN GENERATOR AND CONTROL PANEL
CONNECTION OK?
NO
REFER TO CONTROL PANEL TROUBLESHOOTING FIGURE 6-14
YES
CORRECT GENERATOR TO CONTROL PANEL SERIAL CABLE CONNECTION
YES
CONNECT OSCILLOSCOPE BETWEEN CU PCB U35 PIN 12 AND GND
SERIAL ACTIVITY PRESENT?
NO
REPLACE CU PCB
YES
CONNECT OSCILLOSCOPE BETWEEN CU PCB U35 PIN 11 AND GND
SERIAL ACTIVITY PRESENT?
NO
REPLACE CU PCB
YES
CONNECT OSCILLOSCOPE BETWEEN CU PCB U35 PIN 14 AND GND
SERIAL ACTIVITY PRESENT?
NO
REPLACE CU PCB
YES
REFER TO CONTROL PANEL TROUBLESHOOTING FIGURE 6-14
C1278

FIGURE 6–3 SERIAL COMMUNICATIONS TROUBLESHOOTING

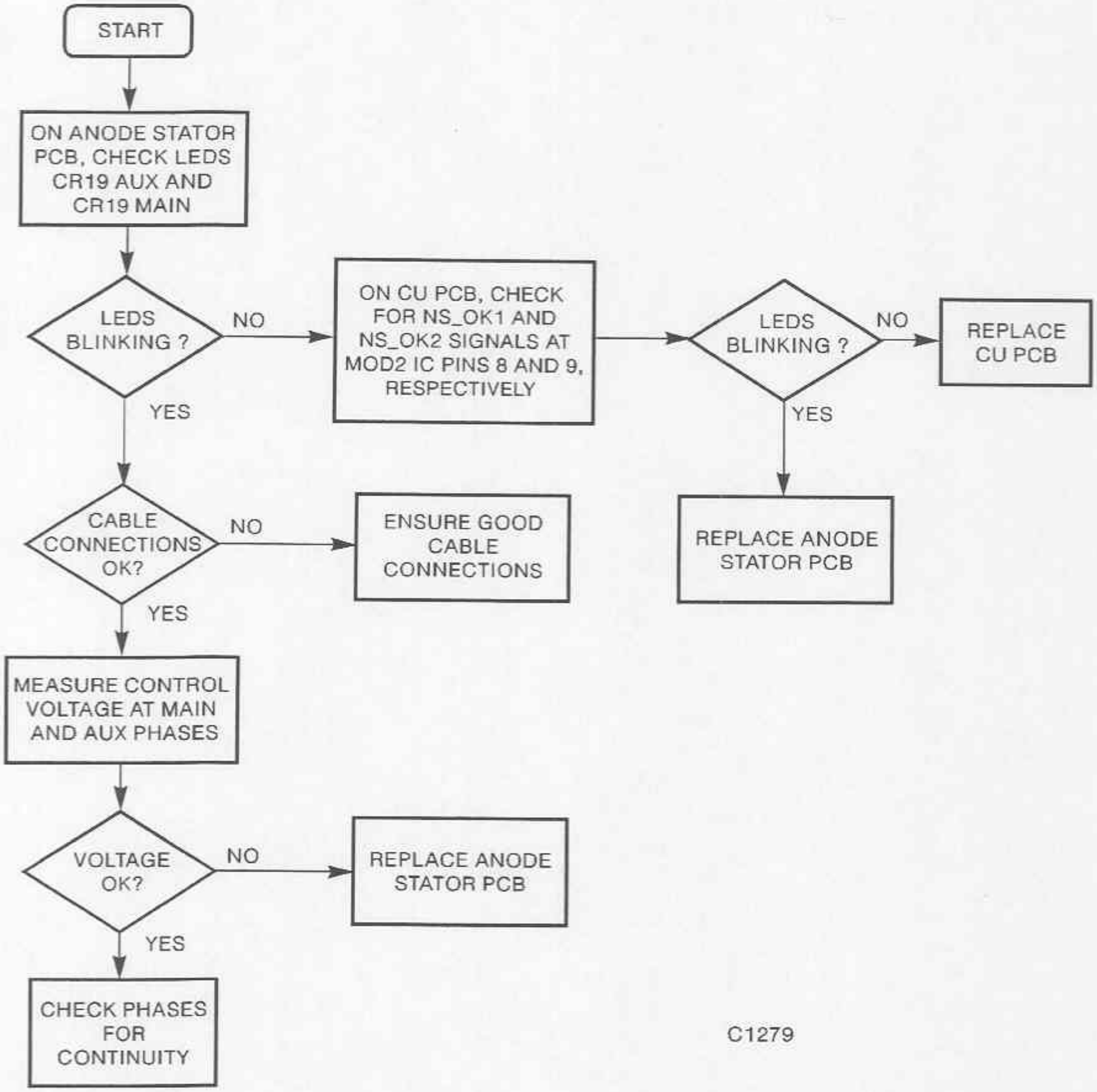

START
ON ANODE STATOR PCB, CHECK LEDS CR19 AUX AND CR19 MAIN
LEDS BLINKING ?
NO
ON CU PCB, CHECK FOR NS_OK1 AND NS_OK2 SIGNALS AT MOD2 IC PINS 8 AND 9, RESPECTIVELY
LEDS BLINKING ?
NO
REPLACE CU PCB
YES
REPLACE ANODE STATOR PCB
YES
CABLE CONNECTIONS OK?
NO
ENSURE GOOD CABLE CONNECTIONS
YES
MEASURE CONTROL VOLTAGE AT MAIN AND AUX PHASES
VOLTAGE OK?
NO
REPLACE ANODE STATOR PCB
YES
CHECK PHASES FOR CONTINUITY
C1279

FIGURE 6–4 ROTOR FAILURE TROUBLESHOOTING

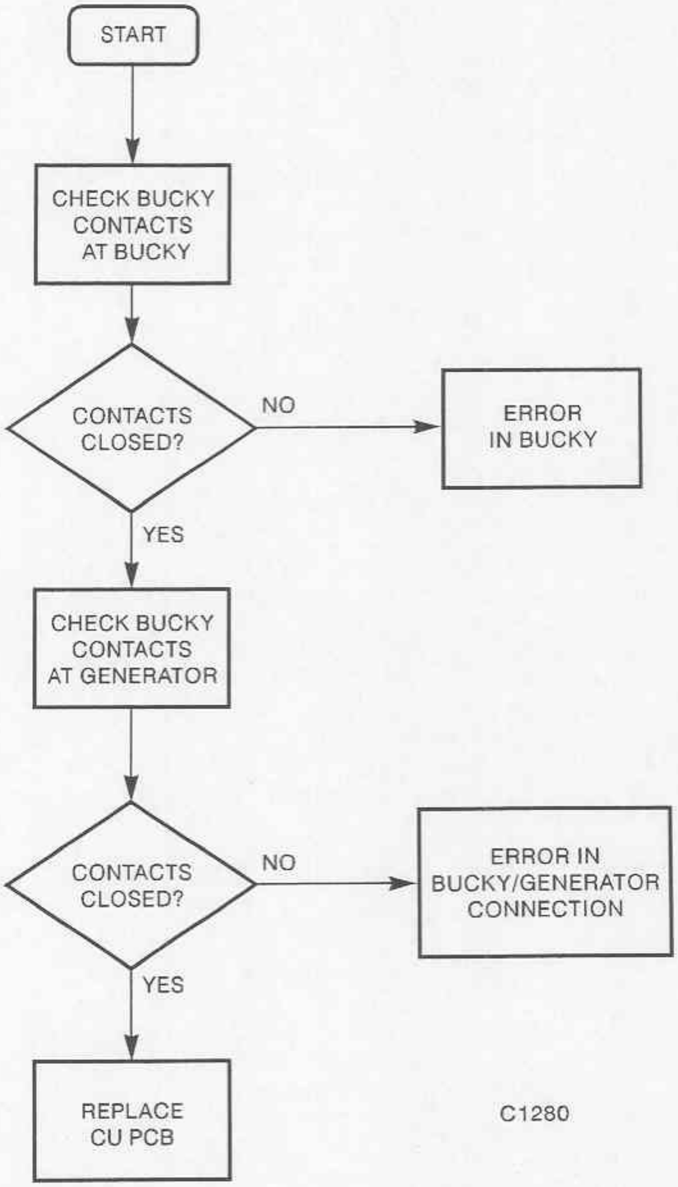

START
CHECK BUCKY CONTACTS AT BUCKY
CONTACTS CLOSED?
NO
ERROR IN BUCKY
YES
CHECK BUCKY CONTACTS AT GENERATOR
CONTACTS CLOSED?
NO
ERROR IN BUCKY/GENERATOR CONNECTION
YES
REPLACE CU PCB
C1280

FIGURE 6–5 BUCKY ERROR TROUBLESHOOTING

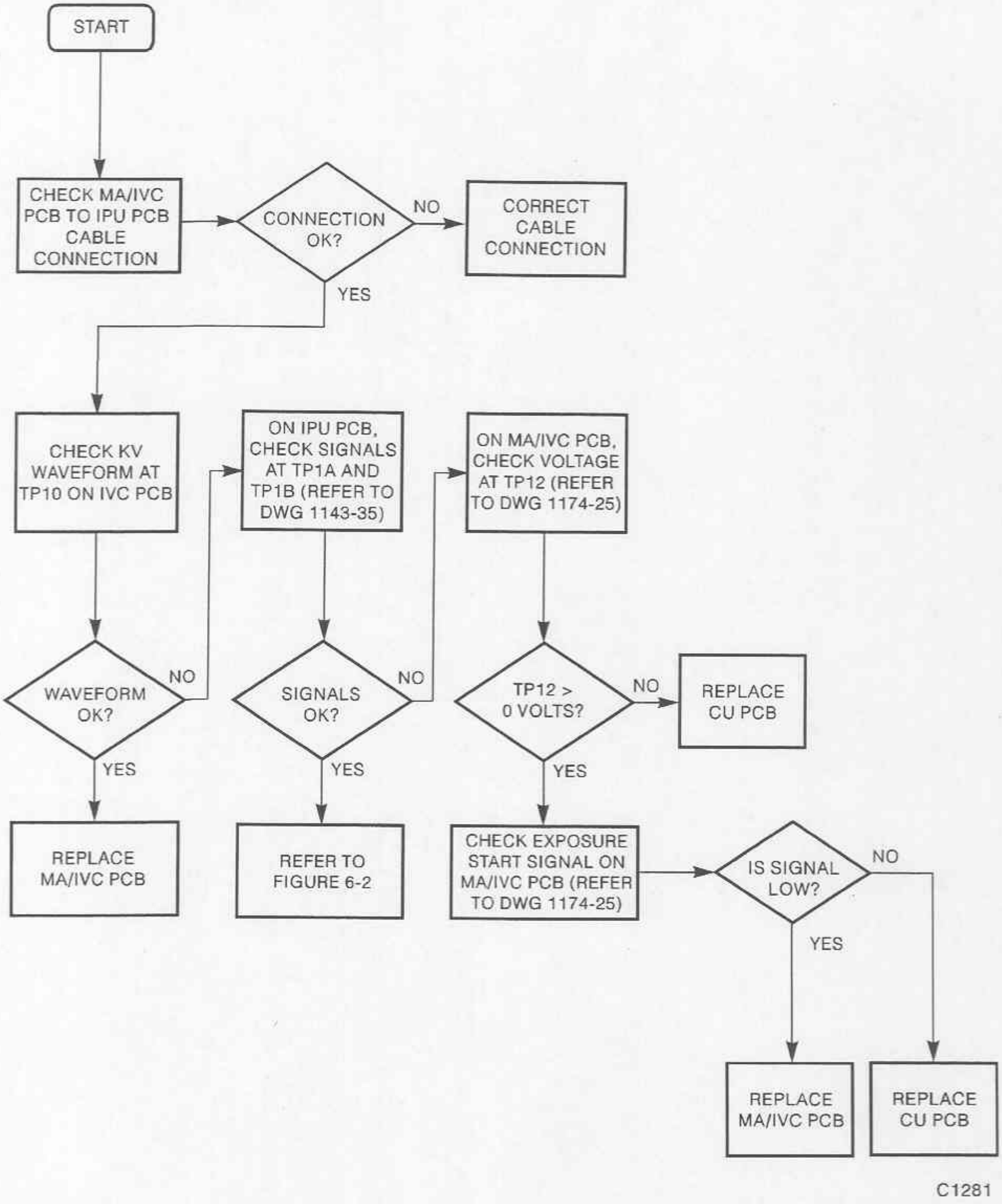

START
CHECK MA/IVC PCB TO IPU PCB CABLE CONNECTION
CONNECTION OK?
NO
CORRECT CABLE CONNECTION
YES
CHECK KV WAVEFORM AT TP10 ON IVC PCB
ON IPU PCB, CHECK SIGNALS AT TP1A AND TP1B (REFER TO DWG 1143-35)
ON MA/IVC PCB, CHECK VOLTAGE AT TP12 (REFER TO DWG 1174-25)
WAVEFORM OK?
NO
SIGNALS OK?
NO
TP12 > 0 VOLTS?
NO
REPLACE CU PCB
YES
YES
YES
REPLACE MA/IVC PCB
REFER TO FIGURE 6-2
CHECK EXPOSURE START SIGNAL ON MA/IVC PCB (REFER TO DWG 1174-25)
IS SIGNAL LOW?
NO
YES
REPLACE MA/IVC PCB
REPLACE CU PCB
C1281

FIGURE 6–6 INVERTER TROUBLESHOOTING

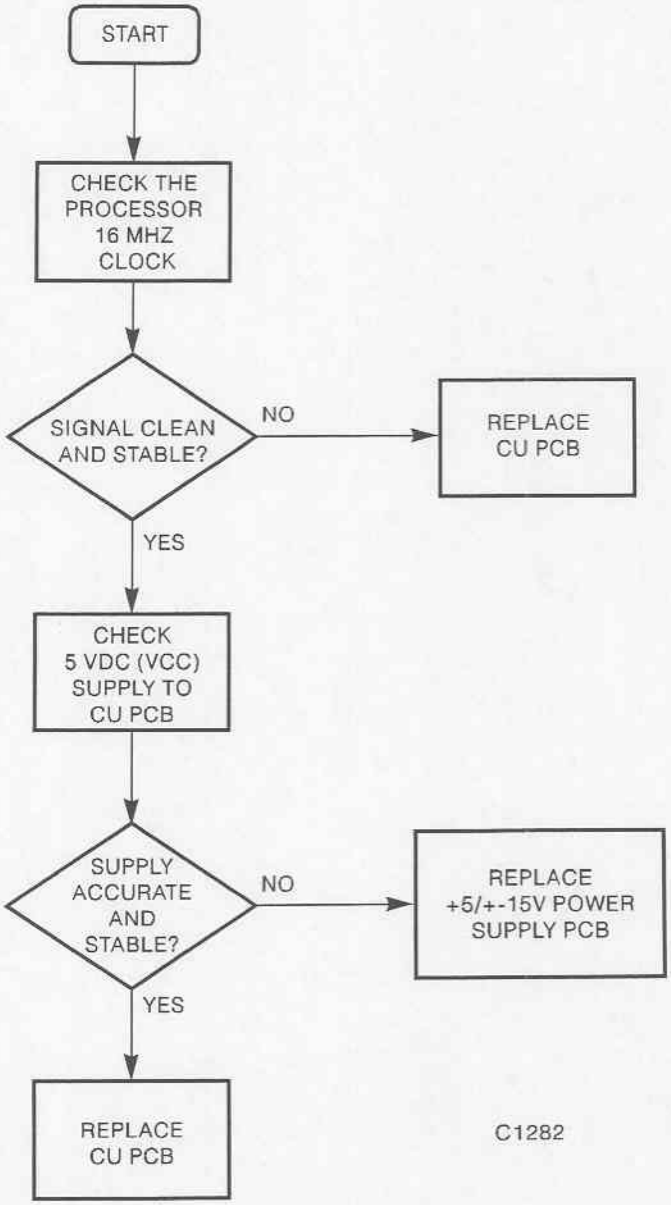

START
CHECK THE PROCESSOR 16 MHZ CLOCK
SIGNAL CLEAN AND STABLE?
NO
REPLACE CU PCB
YES
CHECK 5 VDC (VCC) SUPPLY TO CU PCB
SUPPLY ACCURATE AND STABLE?
NO
REPLACE +5/+-15V POWER SUPPLY PCB
YES
REPLACE CU PCB
C1282

FIGURE 6–7 MICROPROCESSOR WATCHDOG TROUBLESHOOTING

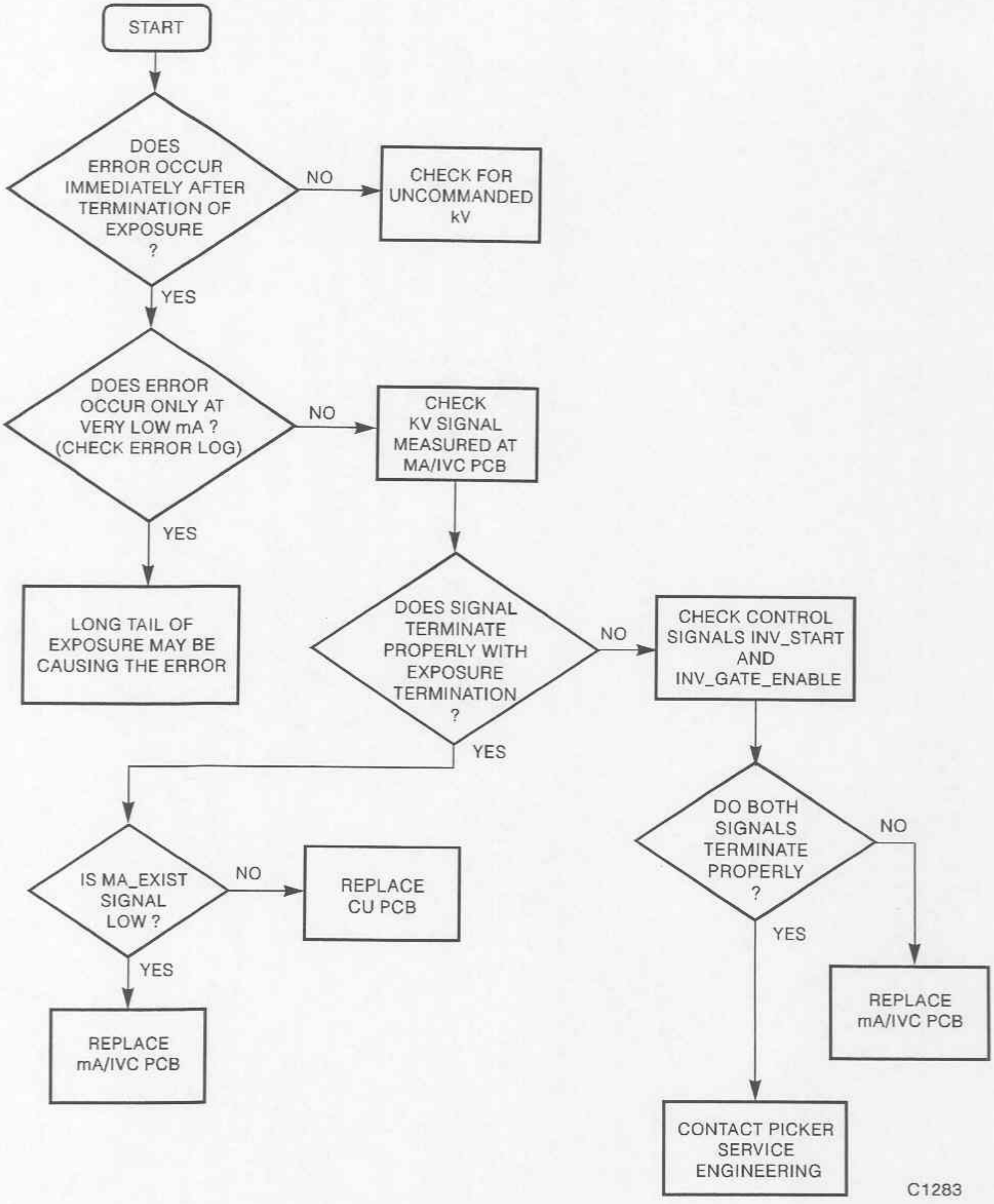

START
DOES ERROR OCCUR IMMEDIATELY AFTER TERMINATION OF EXPOSURE ?
NO
CHECK FOR UNCOMMANDED kV
YES
DOES ERROR OCCUR ONLY AT VERY LOW mA ? (CHECK ERROR LOG)
NO
CHECK KV SIGNAL MEASURED AT MA/IVC PCB
YES
LONG TAIL OF EXPOSURE MAY BE CAUSING THE ERROR
DOES SIGNAL TERMINATE PROPERLY WITH EXPOSURE TERMINATION ?
NO
CHECK CONTROL SIGNALS INV_START AND INV_GATE_ENABLE
YES
DO BOTH SIGNALS TERMINATE PROPERLY ?
NO
IS MA_EXIST SIGNAL LOW ?
NO
REPLACE CU PCB
YES
REPLACE mA/IVC PCB
YES
REPLACE mA/IVC PCB
CONTACT PICKER SERVICE ENGINEERING
C1283

FIGURE 6–8 UNCOMMANDED RADIATION TROUBLESHOOTING

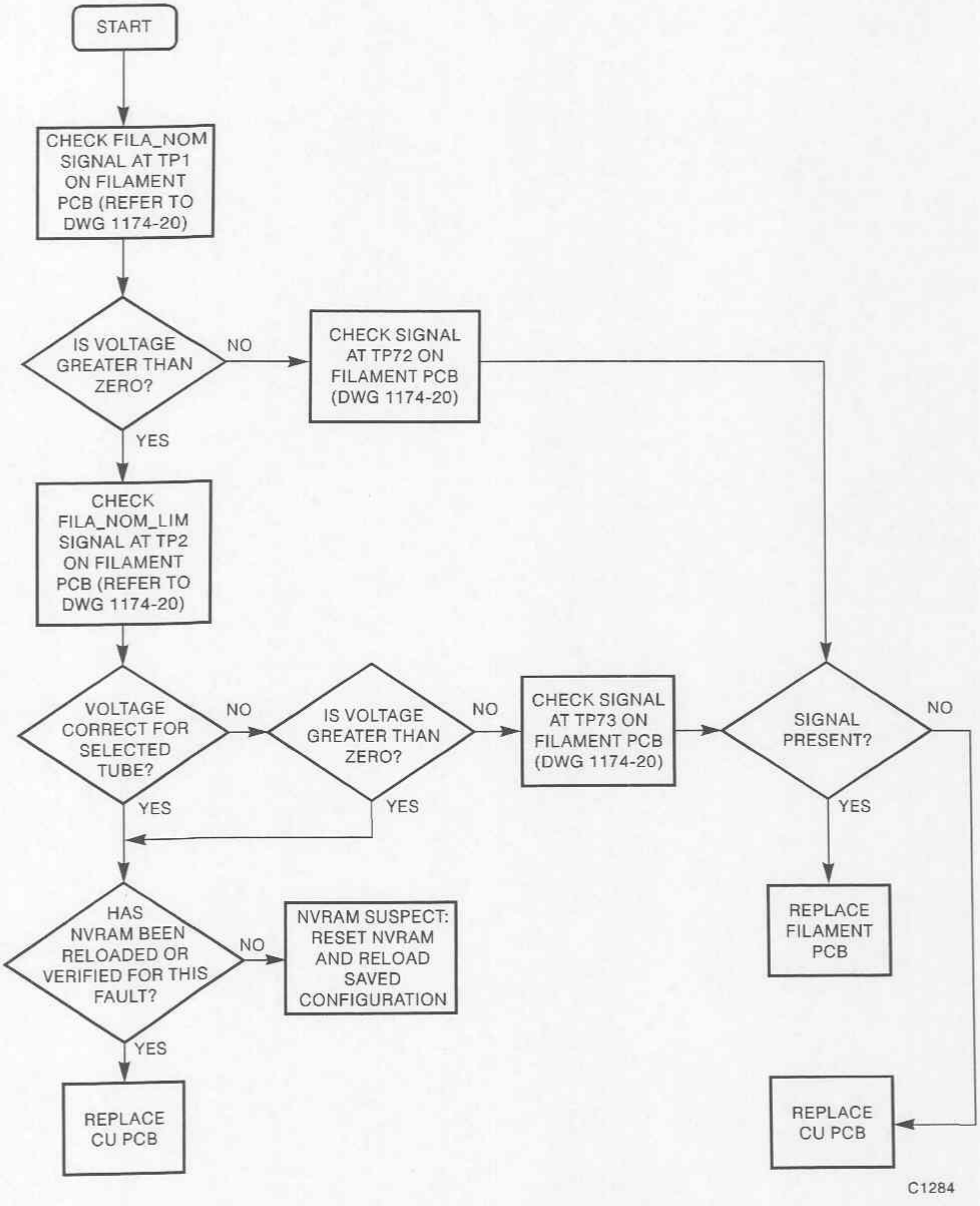
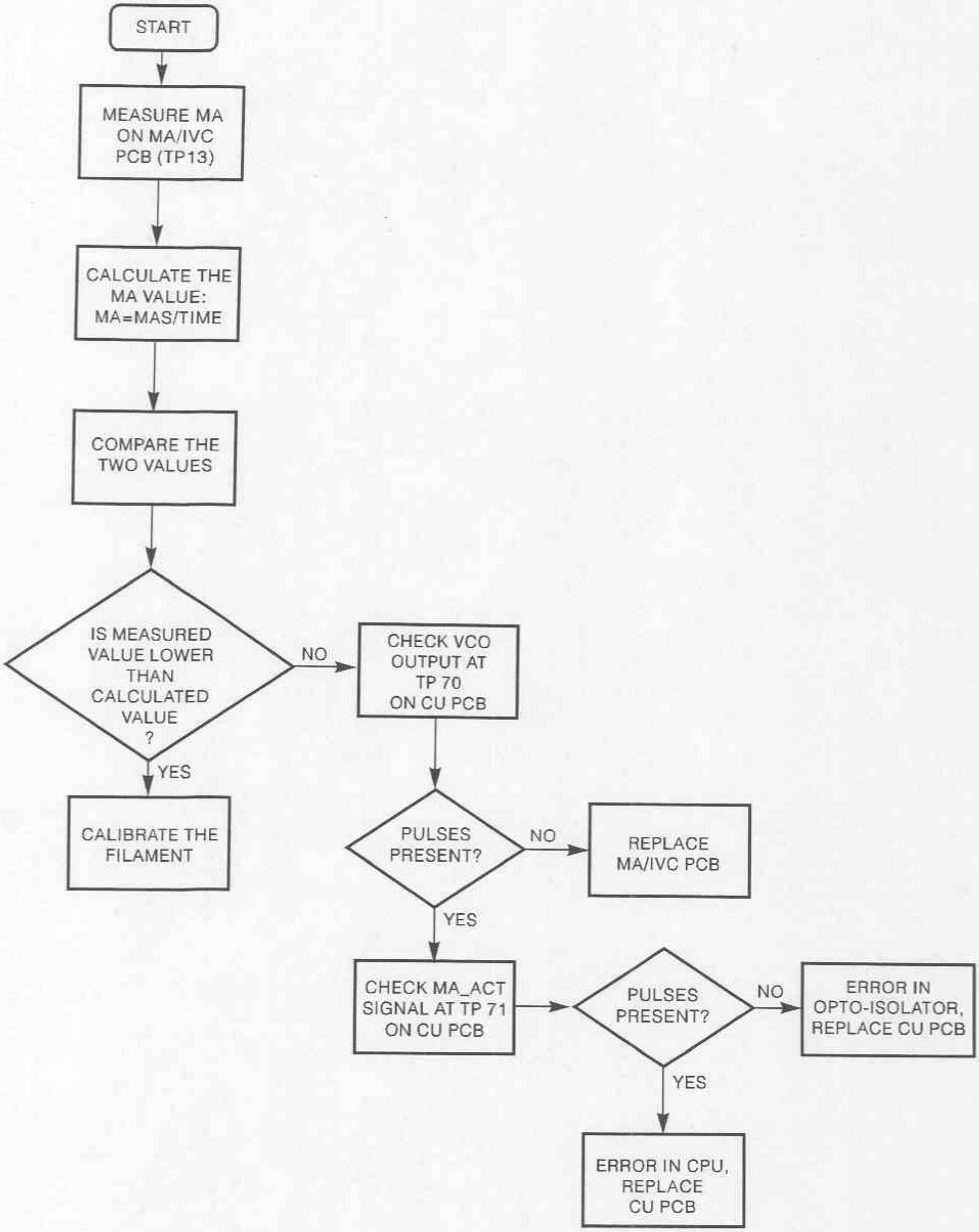

START
CHECK FILA_NOM SIGNAL AT TP1 ON FILAMENT PCB (REFER TO DWG 1174-20)
IS VOLTAGE GREATER THAN ZERO?
NO
CHECK SIGNAL AT TP72 ON FILAMENT PCB (DWG 1174-20)
YES
CHECK FILA_NOM_LIM SIGNAL AT TP2 ON FILAMENT PCB (REFER TO DWG 1174-20)
VOLTAGE CORRECT FOR SELECTED TUBE?
NO
IS VOLTAGE GREATER THAN ZERO?
NO
CHECK SIGNAL AT TP73 ON FILAMENT PCB (DWG 1174-20)
SIGNAL PRESENT?
NO
YES
YES
YES
HAS NVRAM BEEN RELOADED OR VERIFIED FOR THIS FAULT?
NO
NVRAM SUSPECT: RESET NVRAM AND RELOAD SAVED CONFIGURATION
REPLACE FILAMENT PCB
YES
REPLACE CU PCB
REPLACE CU PCB
C1284

FIGURE 6–9 FILAMENT TROUBLESHOOTING


START
MEASURE MA ON MA/IVC PCB (TP13)
CALCULATE THE MA VALUE: MA=MAS/TIME
COMPARE THE TWO VALUES
IS MEASURED VALUE LOWER THAN CALCULATED VALUE ?
YES
CALIBRATE THE FILAMENT
NO
CHECK VCO OUTPUT AT TP 70 ON CU PCB
PULSES PRESENT?
NO
REPLACE MA/IVC PCB
YES
CHECK MA_ACT SIGNAL AT TP 71 ON CU PCB
PULSES PRESENT?
NO
ERROR IN OPTO-ISOLATOR, REPLACE CU PCB
YES
ERROR IN CPU, REPLACE CU PCB

C1285

FIGURE 6–10 SAFETY TIMER TROUBLESHOOTING

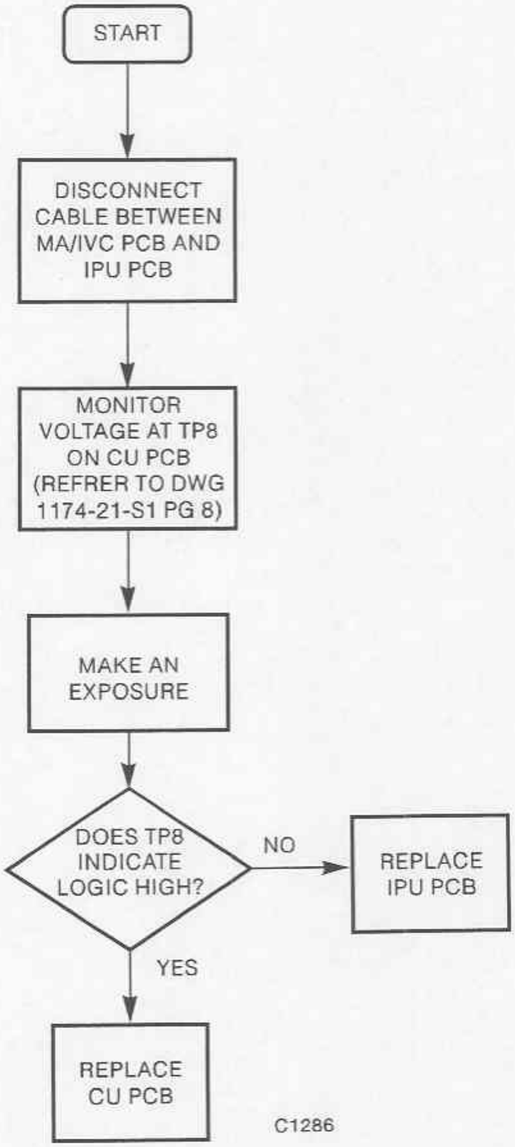

START
DISCONNECT CABLE BETWEEN MA/IVC PCB AND IPU PCB
MONITOR VOLTAGE AT TP8 ON CU PCB (REFRER TO DWG 1174-21-S1 PG 8)
MAKE AN EXPOSURE
DOES TP8 INDICATE LOGIC HIGH?
NO
REPLACE IPU PCB
YES
REPLACE CU PCB
C1286

FIGURE 6–11 KV WATCHDOG TROUBLESHOOTING

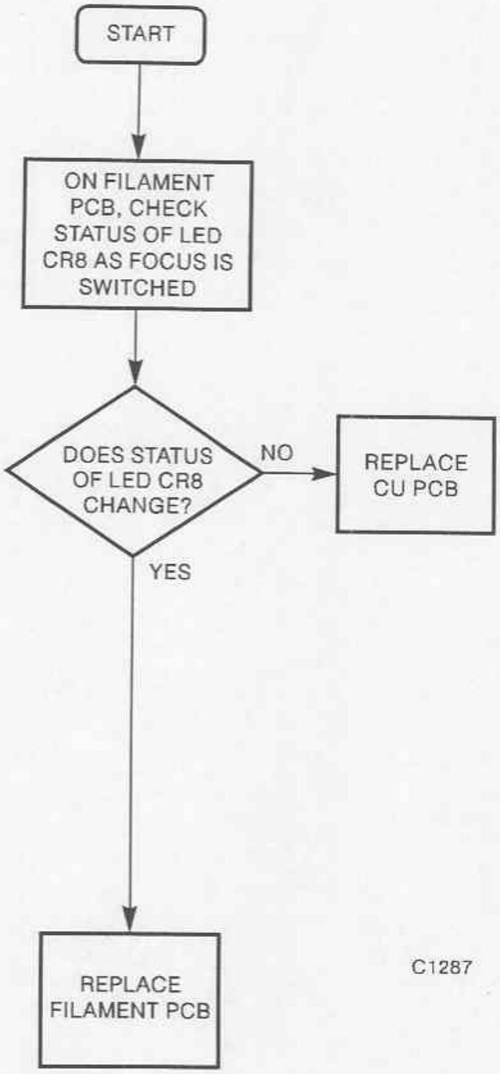

START
ON FILAMENT PCB, CHECK STATUS OF LED CR8 AS FOCUS IS SWITCHED
DOES STATUS OF LED CR8 CHANGE?
NO
REPLACE CU PCB
YES
REPLACE FILAMENT PCB
C1287

FIGURE 6–12 FOCUS RELAY TROUBLESHOOTING

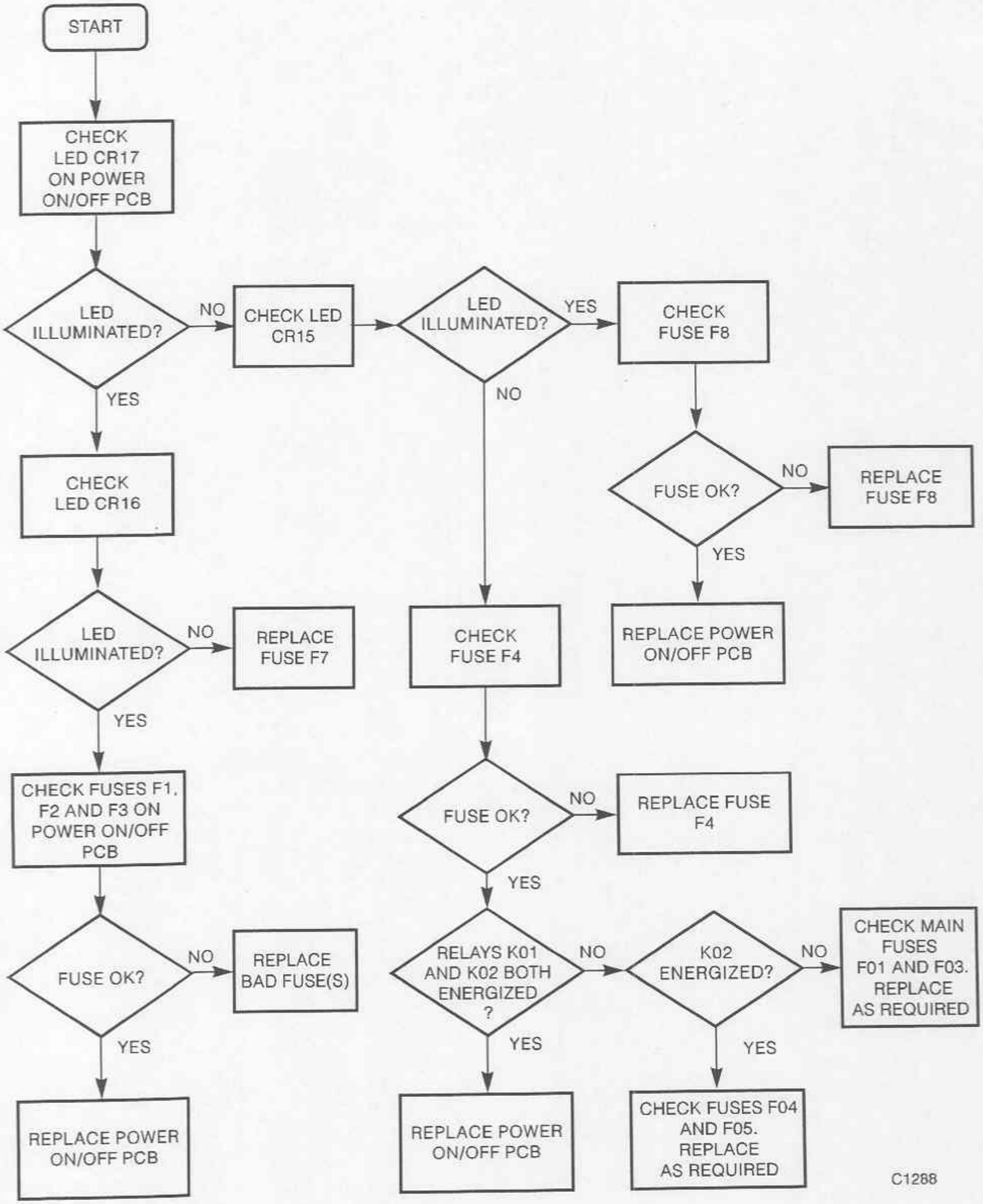

START
CHECK LED CR17 ON POWER ON/OFF PCB
LED ILLUMINATED?
NO
CHECK LED CR15
LED ILLUMINATED?
YES
CHECK FUSE F8
NO
YES
CHECK LED CR16
FUSE OK?
NO
REPLACE FUSE F8
YES
LED ILLUMINATED?
NO
REPLACE FUSE F7
CHECK FUSE F4
REPLACE POWER ON/OFF PCB
YES
CHECK FUSES F1, F2 AND F3 ON POWER ON/OFF PCB
FUSE OK?
NO
REPLACE FUSE F4
YES
FUSE OK?
NO
REPLACE BAD FUSE(S)
RELAYS K01 AND K02 BOTH ENERGIZED ?
NO
K02 ENERGIZED?
NO
CHECK MAIN FUSES F01 AND F03. REPLACE AS REQUIRED
YES
YES
YES
REPLACE POWER ON/OFF PCB
REPLACE POWER ON/OFF PCB
CHECK FUSES F04 AND F05. REPLACE AS REQUIRED
C1288

FIGURE 6–13 POWER SUPPLY TROUBLESHOOTING

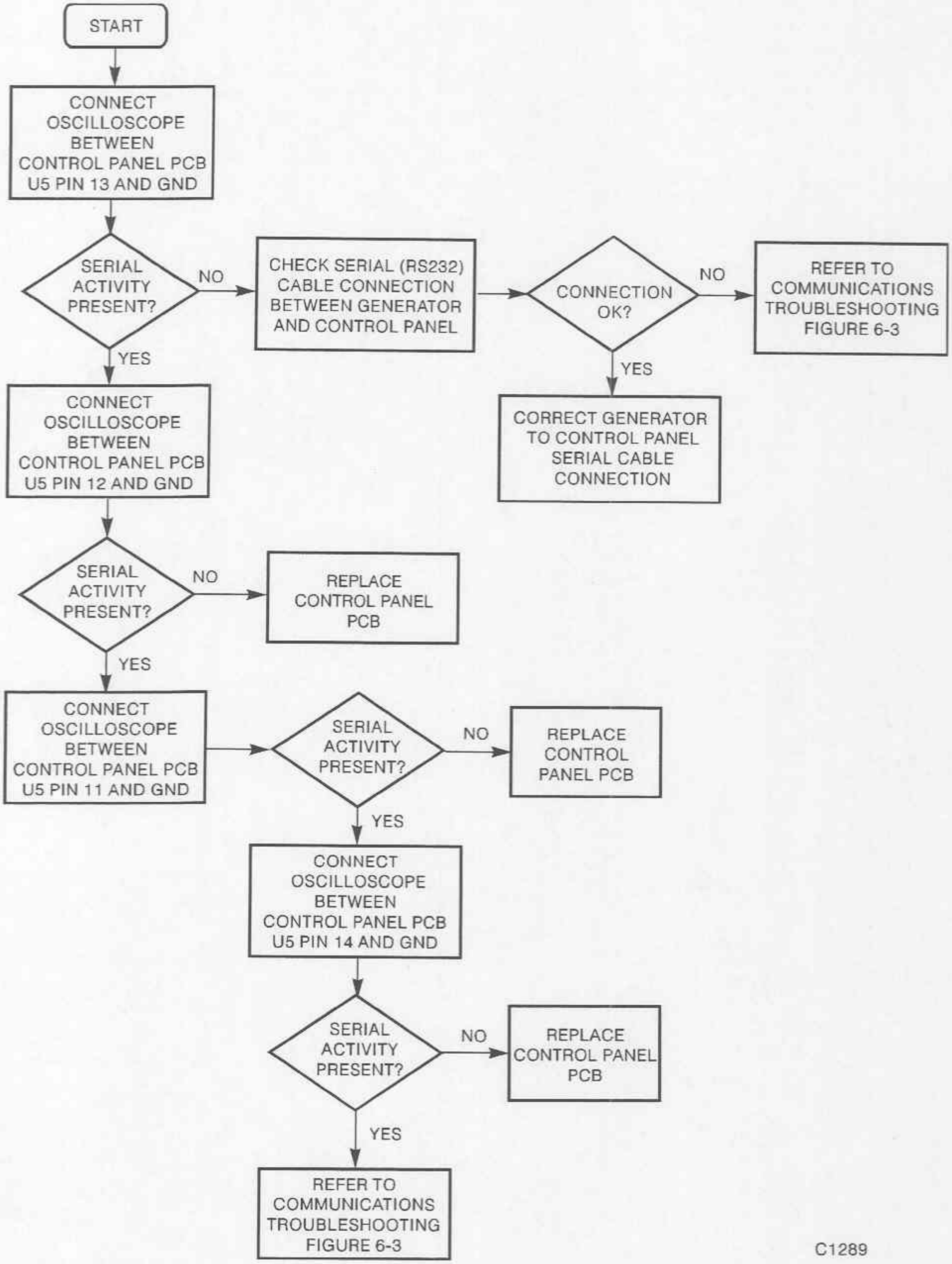

START
CONNECT OSCILLOSCOPE BETWEEN CONTROL PANEL PCB U5 PIN 13 AND GND
SERIAL ACTIVITY PRESENT?
NO
CHECK SERIAL (RS232) CABLE CONNECTION BETWEEN GENERATOR AND CONTROL PANEL
CONNECTION OK?
NO
REFER TO COMMUNICATIONS TROUBLESHOOTING FIGURE 6-3
YES
CORRECT GENERATOR TO CONTROL PANEL SERIAL CABLE CONNECTION
YES
CONNECT OSCILLOSCOPE BETWEEN CONTROL PANEL PCB U5 PIN 12 AND GND
SERIAL ACTIVITY PRESENT?
NO
REPLACE CONTROL PANEL PCB
YES
CONNECT OSCILLOSCOPE BETWEEN CONTROL PANEL PCB U5 PIN 11 AND GND
SERIAL ACTIVITY PRESENT?
NO
REPLACE CONTROL PANEL PCB
YES
CONNECT OSCILLOSCOPE BETWEEN CONTROL PANEL PCB U5 PIN 14 AND GND
SERIAL ACTIVITY PRESENT?
NO
REPLACE CONTROL PANEL PCB
YES
REFER TO COMMUNICATIONS TROUBLESHOOTING FIGURE 6-3
C1289

FIGURE 6–14   CONTROL PANEL TROUBLESHOOTING

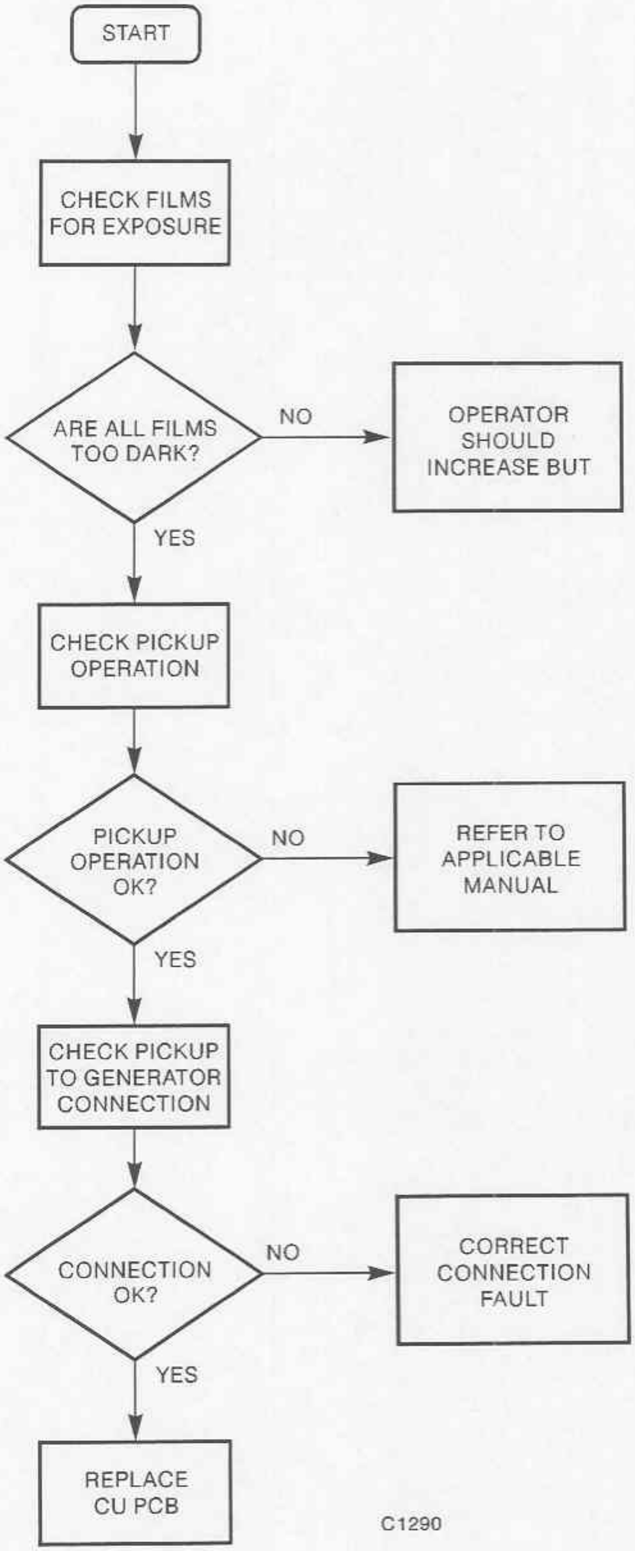

START
CHECK FILMS FOR EXPOSURE
ARE ALL FILMS TOO DARK?
NO
OPERATOR SHOULD INCREASE BUT
YES
CHECK PICKUP OPERATION
PICKUP OPERATION OK?
NO
REFER TO APPLICABLE MANUAL
YES
CHECK PICKUP TO GENERATOR CONNECTION
CONNECTION OK?
NO
CORRECT CONNECTION FAULT
YES
REPLACE CU PCB
C1290

FIGURE 6–15 BACKUP TIMER TROUBLESHOOTING

DIAGNOSTICS

INTRODUCTION

The purpose of this section is to provide service personnel with the information necessary to help diagnose malfunctions in the Clinix VP4 Generator system using the integrated software. This section, used in conjunction with the **ERROR MESSAGES** and **TROUBLESHOOTING** sections will enable the maintainer to remedy virtually any malfunction associated with the Clinix VP4 Generator system.

SPECIAL TOOLS AND EQUIPMENT

No special tools and/or test equipment is required for the Clinix VP4 Generator diagnostic procedures outlined in this section. If special tools and/or equipment are required for any procedure, they will be listed in the reference procedure(s).

SAFETY INFORMATION

All personnel are cautioned to observe all WARNINGS and CAUTIONS as they appear throughout the text of this section. Failure to comply may result in serious or fatal bodily injury to service personnel.

USING THE DIAGNOSTICS

The diagnostics are integrated into the menu structure of the service program. The **Fault Diagnostics** selection in the main function group is used to display exposure counters and for error memory management.

The diagnostics can also be used to restore the generator status parameters that existed at the time of the malfunction. The diagnostics also provide a means of erasing the error memory.

CLINIX VP4 FAULT DIAGNOSTICS (APR$_6$)

1. To select **Fault Diagnostics**, the system must be in service mode. Refer to **Entering Service Mode** in **Service Mode General Information**.
2. After entering service mode, press control console key **APR$_6$**.
3. Using the **kV +** and **kV –** keys, select the desired sub function. The available sub functions are listed and described in **Table 7–1**.

TABLE 7–1 FAULT DIAGNOSTICS SUB FUNCTIONS

Sub Function	Description
Display small focus exposure counter	The mAs-ms display the current value of the small focus exposure counter (0 to 9999999).
Display small focus exposure counter	The mAs-ms display the current value of the large focus exposure counter (0 to 9999999).
Display error memory	1. The mAs display shows the position of the error in the error memory (one is the most recent error, zero indicates that the error memory is empty). 2. The error code (Exxx) is displayed in the ms display.
Erase error memory	The accept key (**APR$_{14}$**) is used to erase the error memory, with a 1 displayed in the ms display.

4. Display error memory as follows:

   a. Use the **mAs +** and **mAs –** keys to scroll through the error memory.

   b. The generator may be restored to the settings that were active at the time of the error by pressing the accept key (**APR$_{14}$**).

NOTE

Restoration of the generator settings occurs when service mode is terminated. A 1 will be displayed in the ms display.

5. The accept key (**APR$_{14}$**) is used to erase the error memory, with a 1 displayed in the ms display.

ERROR MESSAGES

INTRODUCTION

The purpose of this section is to provide service personnel with the error messages associated with the Clinix VP4 Generator system. The error codes, when displayed, appear in the ms portion of the exposure control display. Refer to **Controls and Indicators** section of **Clinix VP4 System Operator's Guide TX008:F** for location of controls and indicators.

The error codes are three-digit code numbers prefixed with an identifying letter (E, H, L, or P). The four error types are describe in **Table 8–1**.

TABLE 8–1 ERROR TYPE LIST

Type	Error Description	See Table
E	Operational	8–2
H	Hints	8–3
L	Limits	8–4
P	Console	8–5

Error messages may occur at any time during operation. When an error is displayed, refer to the applicable table (refer to **Table 8–1**) and find the matching error code in the table. Once the error is found, perform the corrective action provided for the given error.

For example, if an exposure is interrupted by premature release of the exposure key, the message E200 is displayed in the ms display. Locate error code E200 in the first column of the table. The second column provides the nomenclature of the error. The third column provides a description of the error and the fourth column provides the corrective action required. In this example, any key would be pressed to render the system operational again.

ERROR MESSAGE TABLES

The tables contained in this paragraph contain the error codes associated with the Clinix VP4 Generator system and an explanation of each.

TABLE 8–2 OPERATIONAL (E) ERROR CODES

Code	Description	Definition	Corrective Action
E103	Generator RAM	Error in RAM on CU PCB.	Replace CU PCB.
E104	Generator ROM	Error in EPROM on CU PCB.	Replace EPROM.
E105	Generator XRAM	Error in XRAM on CU PCB.	Replace CU PCB.
E107	Communication	Serial data transmission between console and generator interrupted.	Refer to **Figure 6–3**.
E108	Undefined Stopmode	Certain values undefined at exposure termination.	Remove power from system and re-apply.
E109	Transient Stop	Cause of terminated exposure not determined; termination signals too short (less than 20 µsec).	None.
E110	Unexpected mAs Stop	Unexpected termination with normal exposure termination in mAs stop mode, e.g., by: AEC_ STOP, BUCKY_CONTACT, POWER_DOWN.	Use digital I/O status stored at the time of termination to determine which signal caused termination.
E111	Unexpected AEC Stop	Unexpected termination with normal exposure termination in AEC stop mode, e.g., by: BUCKY_ CONTACT, POWER_DOWN.	Use digital I/O status stored at the time of termination to determine which signal caused termination.
E112	Unexpected Bucky Stop	Unexpected termination with normal exposure termination in bucky stop mode, e.g., by: POWER_DOWN.	Use digital I/O status stored at the time of termination to determine which signal caused termination.
E113	Unexpected Calibration Stop	Unexpected termination with normal exposure termination in tube cal stop mode, e.g., by: AEC_STOP, BUCKY_CONTACT, POWER_DOWN.	Use digital I/O status stored at the time of termination to determine which signal caused termination.
E200	Operator Interrupt	Termination of exposure in process by operator.	Hold exposure switch throughout entire exposure sequence.
E300	Filament	Measured filament current is less than 1.5A.	Check for open filament in tube or poor connection on cathode cable.
E301	Rotor Failure (Normal Speed)	No current flowing through main phase or auxiliary phase (NS_OK1 and NS_OK2).	Refer to **Figure 6–4**.
E302	No Bucky	No bucky feedback within two (2) seconds after BUCKY_START signal.	Refer to **Figure 6–5**.

TABLE 8–2 OPERATIONAL ERROR CODES (CONTINUED)

Code	Description	Definition	Corrective Action
E350	No kV mA	75% of nominal voltage was not obtained and no tube current was measured within 40 mS of energizing inverter.	Refer to **Figure 6–6**.
E401	Watchdog	Microprocessor watchdog in generator has executed a reset.	Refer to **Figure 6–7**.
E402	Cathode mA	Cathode overcurrent.	None.
E403	Anode mA	Anode overcurrent.	None.
E404	Post Exposure mA	Radiation outside of exposure. The detector is released 80 mS after end of exposure.	Refer to **Figure 6–8**.
E405	Filament Over	Measured filament current is greater than 5.9 A.	Refer to **Figure 6–9**.
E406	Safety Timer	Safety timer has terminated the exposure due to mA timing not terminating exposure.	Refer to **Figure 6–10**.
E407	kV Over	Voltage exceeded 150 + 10% (165) kV.	1. Calibrate the tube current. 2. Check adjustment of overvoltage detector.
E408	AEC Over	AEC overcurrent in multiplier section.	Check for error in multiplier supply or a short in multiplier connections.
E409	kV Watchdog Stop	kV watchdog has not triggered and has lapsed.	Refer to **Figure 6–11**.
E410	Focus Relay	Contact position of focus relay does not correspond to focus relay control.	Refer to **Figure 6–12**.
E411	Analog Supply	The ±15 Vdc and/or the 5 Vdc supply voltages are outside of the ± 5% allowable tolerance.	Refer to **Figure 6–2**.
E412	C01 Not Charged	Power bus capacitors are not charged due to an open fuse and K02 has been inhibited.	Refer to **Figure 6–13**.

TABLE 8–3 HINT (H) ERROR CODES

Code	Description	Definition	Corrective Action
H800	Filament Did Not Calibrate	Tube current is outside of tolerance even after ten calibration exposures in calibration mode.	1. Change starting value. 2. Usually the cause lies elsewhere, e.g., the mA is not measured correctly.
H951	Collimator Interlock	Collimator interlock logic not satisfied.	1. Check for filter. 2. Refer to applicable Collimator manual.
H952	Prep Timeout	Prep switch depressed too long. Default is 20 seconds.	1. Release Prep switch within time limit. 2. Check function of Prep switch.
H953	Backup Timer	Backup timer (mAs) terminated an AEC exposure.	Refer to **Figure 6–15**.
H954	Generator Busy	Generator not ready to receive data from Service PC.	Acknowledge by pressing the Enter key on the Service PC.
H955	Calibration Mode	Generator operating in tube calibration mode. No exposures are possible.	Complete tube calibration.
H956	Filament Not Calibrated	Selected focus is not calibrated or filament is in error.	1. Select different focus. 2. Calibrate filament.
H957	Manual Mode	Generator I/O's are under control of Service PC. Operation from control panel not possible.	Exit Service PC mode or cycle power to generator.
H958	Uncalibrated Screen	A sensitivity (film/screen speed) level has not been programmed for the selected screen button.	Use service mode (**APR$_5$**) to program the screen button or select another screen.
H959	PBL Error	Collimator is inhibiting exposure.	1. Check for proper SID. 2. Check PBL inputs to collimator control.

TABLE 8–4 LIMIT (L) ERROR CODES

Code	Description	Definition	Corrective Action
L900	MS Limit	Projected exposure duration is longer than the specified exposure duration.	Select a lower mAs or large focus.
L901	MA Limit	Selection is requiring mA values lower than 10 mA in tomo mode or 50 mA with long exposure times.	Select shorter time or higher mA.
L902	Illegal Configuration	NVRAM data is new or defective.	Configure the generator NVRAM.

TABLE 8–5 CONTROL PANEL (P) ERROR CODES

Code	Description	Definition	Corrective Action
P200	Serial I/O Initialization Error	Interface cannot be initialized when the generator is turned on.	Refer to **Figure 6–3**.
P201	Serial I/O Down	Communication noisy between console and generator.	Refer to **Figure 6–3**.

END OF MANUAL

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Installation Manual

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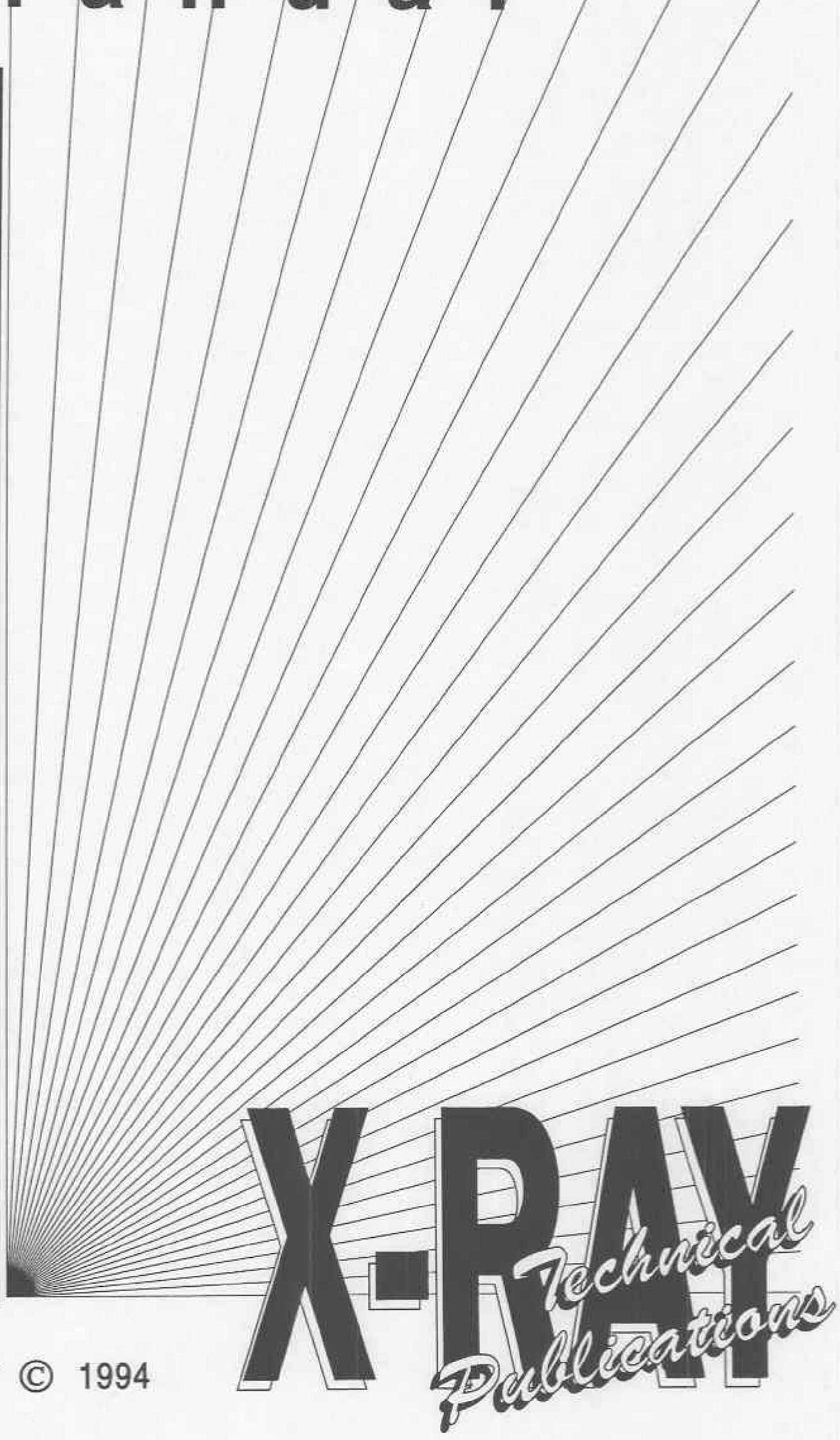
Clinix VP4
Collimator

DRS No.
SX008:TM

Part No.
T55E-1073



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NOTICE

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Diagnostic X-ray Systems

RADIATION WARNING

X-RAY AND GAMMA-RAYS ARE DANGEROUS TO BOTH OPERATOR AND OTHERS IN THE VICINITY UNLESS ESTABLISHED SAFE EXPOSURE PROCEDURES ARE STRICTLY OBSERVED.

THE USEFUL AND SCATTERED BEAMS CAN PRODUCE SERIOUS OR FATAL BODILY INJURIES TO ANY PERSONS IN THE SURROUNDING AREA IF USED BY AN UNSKILLED OPERATOR. ADEQUATE PRECAUTIONS MUST ALWAYS BE TAKEN TO AVOID EXPOSURE TO THE USEFUL BEAM, AS WELL AS TO SCATTERED RADIATION RESULTING FROM THE PASSAGE OF RADIATION THROUGH MATTER.

THOSE AUTHORIZED TO OPERATE, PARTICIPATE IN, OR SUPERVISE THE OPERATION OF THE EQUIPMENT MUST BE THOROUGHLY FAMILIAR AND COMPLY COMPLETELY WITH THE CURRENT ESTABLISHED SAFE EXPOSURE FACTORS AND PROCEDURES DESCRIBED IN PUBLICATIONS, SUCH AS: SUBCHAPTER J OF TITLE 21 OF THE CODE OF FEDERAL REGULATIONS, "DIAGNOSTIC X-RAY SYSTEMS AND THEIR MAJOR COMPONENTS," AND THE NATIONAL COUNCIL ON RADIATION PROTECTION (NCRP) NO. 102, "MEDICAL X-RAY AND GAMMA-RAY PROTECTION FOR ENERGIES UP TO 10 MEV-EQUIPMENT DESIGN AND USE," AS REVISED OR REPLACED IN THE FUTURE.

THOSE RESPONSIBLE FOR THE PLANNING OF X-RAY AND GAMMA-RAY EQUIPMENT INSTALLATIONS MUST BE THOROUGHLY FAMILIAR AND COMPLY COMPLETELY WITH NCRP NO. 49, "STRUCTURAL SHIELDING DESIGN AND EVALUATION FOR MEDICAL OF X-RAYS AND GAMMA-RAYS OF ENERGIES UP TO 10 MEV," AS REVISED OR REPLACED IN THE FUTURE.

FAILURE TO OBSERVE THESE WARNINGS MAY CAUSE SERIOUS OR FATAL BODILY INJURIES TO THE OPERATOR OR THOSE IN THE AREA.

Diagnostic X-ray Systems

MECHANICAL - ELECTRICAL WARNING

ALL OF THE MOVEABLE ASSEMBLIES AND PARTS OF THIS EQUIPMENT SHOULD BE OPERATED WITH CARE AND ROUTINELY INSPECTED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS CONTAINED IN THE EQUIPMENT MANUALS.

ONLY PROPERLY TRAINED AND QUALIFIED PERSONNEL SHOULD BE PERMITTED ACCESS TO ANY INTERNAL PARTS. LIVE ELECTRICAL TERMINALS ARE DEADLY; BE SURE LINE DISCONNECT SWITCHES ARE OPENED AND OTHER APPROPRIATE PRECAUTIONS ARE TAKEN BEFORE OPENING ACCESS DOORS, REMOVING ENCLOSURE PANELS, OR ATTACHING ACCESSORIES.

DO NOT REMOVE FLEXIBLE HIGH TENSION CABLES FROM X-RAY TUBE HOUSING OR HIGH TENSION GENERATOR AND/OR ACCESS COVERS FROM GENERATOR UNTIL THE MAIN AND AUXILIARY POWER SUPPLIES HAVE BEEN DISCONNECTED.

FAILURE TO COMPLY WITH THE FOREGOING MAY RESULT IN SERIOUS OR FATAL BODILY INJURIES TO THE OPERATOR OR THOSE IN THE AREA.

ELECTRICAL GROUNDING INSTRUCTIONS

THE EQUIPMENT MUST BE GROUNDED TO AN EARTH GROUND BY A SEPARATE CONDUCTOR. THE NEUTRAL SIDE OF THE LINE IS NOT TO BE CONSIDERED THE EARTH GROUND. ON EQUIPMENT PROVIDED WITH A LINE CORD, THE EQUIPMENT MUST BE CONNECTED TO A PROPERLY GROUNDED, THREE-PIN RECEPTACLE. DO NOT USE A THREE-TO-TWO PIN ADAPTER.

INSTALLATION AND ENVIRONMENT

EXCEPT FOR INSTALLATIONS REQUIRING CERTIFICATION BY THE MANUFACTURER PER FEDERAL STANDARDS, SEE THAT A RADIATION PROTECTION SURVEY IS MADE BY A QUALIFIED EXPERT IN ACCORDANCE WITH NCRP 102, SECTION 7, AS REVISED OR REPLACED IN THE FUTURE. PERFORM A SURVEY AFTER EVERY CHANGE IN EQUIPMENT, WORKLOAD, OR OPERATING CONDITIONS WHICH MIGHT SIGNIFICANTLY INCREASE THE PROBABILITY OF PERSONS RECEIVING MORE THAN THE MAXIMUM PERMISSIBLE DOSE EQUIVALENT.

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THE USER OF THIS MANUAL IS DIRECTED TO READ AND CAREFULLY REVIEW THE INSTRUCTIONS, WARNINGS AND CAUTIONS CONTAINED HEREIN PRIOR TO BEGINNING INSTALLATION OR SERVICE ACTIVITIES. WHILE YOU MAY HAVE PREVIOUSLY INSTALLED OR SERVICED EQUIPMENT SIMILAR TO THAT DESCRIBED IN THIS MANUAL, CHANGES IN DESIGN, MANUFACTURE OR PROCEDURE MAY HAVE OCCURRED WHICH SIGNIFICANTLY AFFECT THE PRESENT INSTALLATION OR SERVICE.

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EQUIPMENT DESCRIPTION

INTRODUCTION

The collimator system consists of two basic units, the collimator control unit shown in **Figure 1-1** and the collimator head shown in **Figure 1-2.** The collimator control unit contains the power supply and microprocessor control circuitry to coordinate the shutter openings with SID and the size of the film cassette. Connections to the control chassis are made by factory-installed cables. The collimator control unit is factory mounted on the foot end of the generator chassis inside the Clinix VP4 table base.

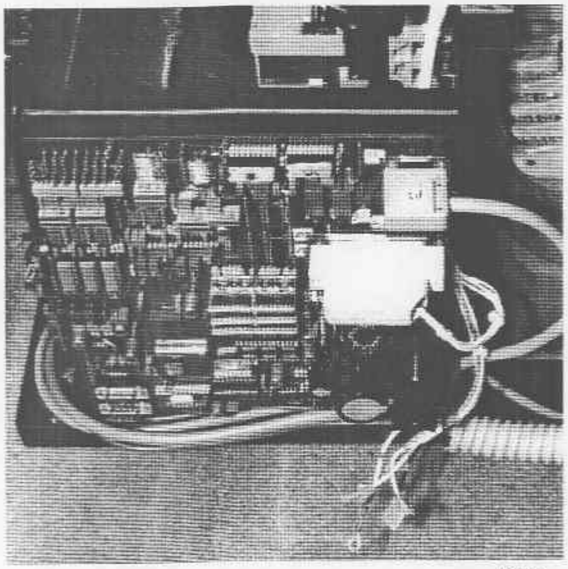
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FIGURE 1-1 CONTROL UNIT

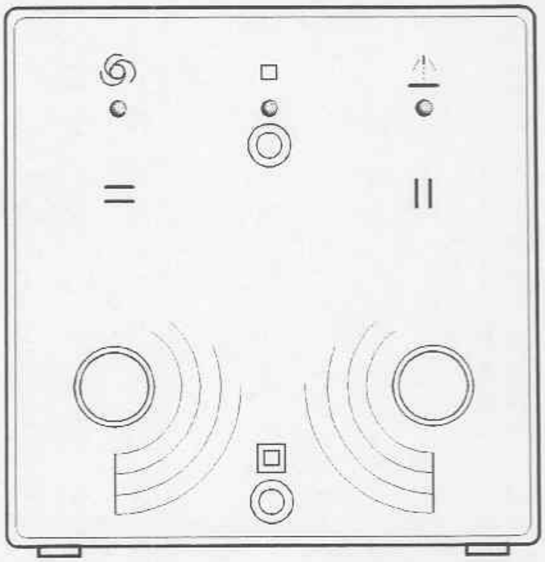

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FIGURE 1-2 COLLIMATOR

The collimator on the Clinix VP4 is an automatic X-ray beam collimator that mounts to an X-ray tube. In conjunction with the collimator control unit, it automatically controls the X-ray field size to equal the film size in the cassette. This is accomplished with two pairs of lead shutters which are motor driven within the collimator, one motor driving the transverse shutters and one driving the longitudinal shutters.

Additionally, an off-focal vane assembly mounted on the top housing protrudes into the tube port to reduce penumbra. A high intensity lamp is incorporated to provide field illumination. Finally, the collimator mounting assembly provides rotational capability about the central axis of the X-ray beam.

COLLIMATOR FIELD LAMP

The collimator is equipped with a quartz iodide field lamp. The field lamp projects a visible center mark that corresponds to the center of the X-ray beam (within 2% of the SID). The center of the light field is projected onto the subject by the shadow of two perpendicular lines that are silk-screened onto the lexan window through which the light beam passes. This provides the operator with a direct visualization of the area targeted for the X-ray image.

The field light is activated by pressing the front panel membrane switch marked by the light symbol. Once the light is activated it will remain on for 30 seconds before turning off automatically. The average illumination is not less than 160 lux (16 foot-candles) and the edge contrast ratio is four to one.

COLLIMATOR HEAD SPECIFICATIONS

Maximum protection against radiation leakage:	150 kVp
Inherent filtration (Al. equivalent in.):	2.0 mm minimum
Lamp voltage:	24 VAC or DC

COLLIMATOR CONTROLS

The functions of the collimator controls shown in **Figure 1-3** are as follows:

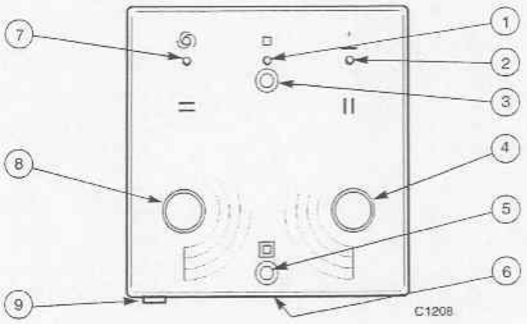


FIGURE 1-3 COLLIMATOR CONTROLS

1. Signal lamp illuminates when manual collimation mode is selected.
2. Signal lamp illuminates when the X-ray field is greater than the cassette size.
3. Push-button for selecting manual collimation mode.
4. Rotary knob for manual opening and closing of collimator vanes (longitudinally to tabletop).
5. Push-button for turning on collimator light (approx. 30 seconds).
6. Cassette centering light
7. Signal lamp illuminates when conditions for automatic collimation are met (cassette in Bucky tray, X-ray tube unit in 36" - MAX." SID range, vertical central ray).
8. Rotary knob for manual opening and closing of collimator vanes (transversely to tabletop).
9. Measuring tape

THEORY OF OPERATION

COLLIMATOR CONTROL UNIT

This section is intended to acquaint the Service Engineer with the overall operation of the collimator control unit circuitry. A basic understanding of the information contained in this section will be of benefit.

The collimator system consists of two basic units, the collimator head and the collimator control unit. The collimator control unit shown in **Figure 2-1** contains the power supply and microprocessor control circuitry to coordinate the shutter openings with SID and the size of the film cassette. Connections to the control chassis are made by factory supplied cables. The collimator control unit is factory mounted in the Clinix VP4 table base.

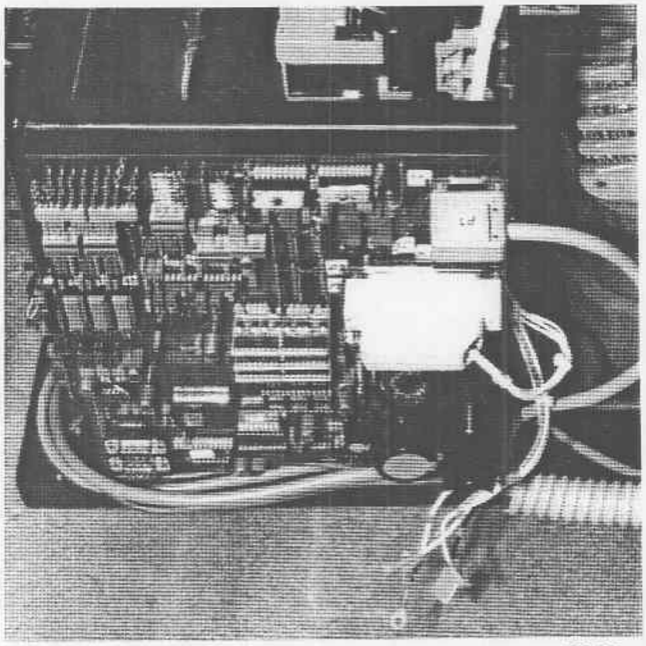


FIGURE 2-1 COLLIMATOR CONTROL UNIT

CONTROL UNIT FUNCTIONAL DESCRIPTION

Refer to Collimator Control Drawing # 15674-20 and to Block Circuit Diagram 15674-20-S1/.. Page 1

The collimator control consists of seven functional units:

- Processor Electronics
- Digital Inputs
- Digital Outputs
- Analog Inputs
- PWM Motor Control
- Power Supply
- Plug Connector and Collimator Light Beam Control

PROCESSOR ELECTRONICS

(Circuit Diagram 15674-20-S1/.. Page 2)

The processor electronics consists of the following functional units:

- CPU SAB80C517A
- Low byte address/data demultiplexer
- Memory and address decoding
- 5 V power fail and reset logic
- +15 V and -Uopv power fail logic

CPU SAB80C517A

(Circuit Diagram 15674-20-S1.. Page 2)

The CPU U23 is based on the 8051 8-bit processor element with additional integrated functions:

- Four 16-bit timers
- One 16-bit compare/capture unit, e.g. for generating PWM signals
- Nine multifunctional I/O ports
- Multiplication/division unit (MDU) for 32-bit division and 16-bit multiplication
- Two serial interfaces with mutually independent programmable baud rate generators
- 256x8 on-chip RAM
- 2Kx8 on-chip Ram in the XRAM area
- Memory management on two each 64K external RAM and ROM
- Eight data pointers for addressing external memory
- 10-bit analog/digital converter with 12 multiplexed inputs
- Programmable watchdog timer with release via hardware or software
- Oscillator watchdog for monitoring the on-chip oscillators
- Hardware lockable, software controllable power savings modes
- 17 interrupt vectors with four selectable priority levels

The CPU is provided with its work clock pulse by the interconnected 16 MHz quartz crystal Y1 via the connectors XTAL1 and XTAL2.

Upon turning ON the power supply, the CPU is reset by the /RESET input through a LOW signal, and begins to execute the program stored in the program memory.

The LOW signal at the /RESET connection must be present for at least two clock cycles.

The RESET output /RO provides a synchronized /RESET signal (LOW signal) to the interconnected peripheral devices.

This signal can be triggered by a hardware reset (at the /RESET connection), a watchdog timer reset or an oscillator watchdog reset.

The connection /EA is fixed at a LOW signal. This notifies the processor that all program commands must be retrieved from an externally connected program memory.

The input /HWPD is fixed at a HIGH signal. This prevents an external hardware power-down.

The ports P0 and P2 of the CPU provide the address and data lines for the externally interconnected program / data memories and I/O expansions.

Access to program and data memories is controlled by the signal /PSEN.

The program memory is accessed through /PSEN-LOW.

The data memory and I/O expansions are accessed through /PSEN-LOW

Reading/writing of the data memory and I/O expansions is controlled with the signals /WR and /RD.

Data are written to the data memory and to the I/O expansions through /WR-LOW.

Data are read from the data memory and from the I/O expansions through /RD-LOW.

CPU Jumpers:

Jumper JP5 at the CPU connection OWE determines the function of the oscillator watchdogs. Refer to **Table 2-1.**

TABLE 2-1 CPU JUMPER JP5

CPU CONNECTION O WE	FUNCTION	JP5
HIGH	Release oscillator watchdogs	1,2
LOW (standard)	Inhibit oscillator watchdogs	2,3

Jumper JP7 at the CPU connection PE/SWD determines the power savings modes and the release of the watchdog timer. Refer to **Table 2-2.**

TABLE 2-2 CPU JUMPER JP7

CPU Connection PE/SWD	Function	JP7
HIGH	The power savings modes are inhibited and the watchdog timer is immediately started following a RESE	1,2
LOW (standard)	All software-controlled power savings modes are released. The watchdog timer is inhibited after a RESET and can only be released by software.	2,3

LOW BYTE ADDRESS/DATA DEMULTIPLEXER

(Circuit Diagram 15674-20-S1/.. Page 2)

In the component U18 (74HCT573), among the multiplexed address/data lines AD0 through AD7, the address lines A0 through A7 are buffered whenever the CPU output /ALE is HIGH.

These lines, together with the address lines from the CPU port P2, are used to form the address bus A0-A15.

MEMORY AND ADDRESS DECODING

(Circuit Diagram 15674-20-S1/.. Page 3)

The address decoding for the memory components and I/O expansions is accomplished through a programmable component GAL20V8 (U26).

The address signals A7 through A15, in conjunction with the control signals /PSEN, /RD, /WR, /RESET, and /ENABLE_DATA, are used to generate the corresponding chip select signals.

Up to 64K x 8 can be applied as program memory U25. At present, a 2K x 8 EEPROM is used as data memory. A data memory expansion can be achieved through a change in address decoding of U26 and a change in the settings of the jumpers JP9, JP26 and JP27.

Program Memory U25 Jumper JP8

The jumper JP8 is used to establish the memory component size. Refer to **Table 2-3.**

TABLE 2-3 PROGRAM MEMORY U25 JUMPER JP8

Program Memory	JP8
32k x 8 (27C256)	2,3
64k x 8 (27C512)	1,2

Data Memory U27 Jumpers JP9, JP26 and JP27

The jumpers JP9, JP26 and JP27 are used to establish the memory component size. Refer to **Table 2-4.**

TABLE 2-4 DATA MEMORY U27 JUMPERS

Data Memory	JP9	JP26	JP27
2k x 8 (X28HC16)	1,2	OPEN	1,2
8k x 8 (bq4010)	2,3	OPEN	1,2
32k x 8 (bq4011)	2,3	CLOSED	2,3

When replacing the data memory U27 with a larger memory component, a change is needed in the programming of the address decoder U26.

Configuration Switch S1

The component U24 (74HCT245) makes it possible to read the status of the configuration switches S1/1 through S1/8.

The various programming functions are selected by setting these switches (refer to the Programming procedure in the calibration section of this manual).

The data memory can be write-protected with the software-controlled signal /ENABLE_DATA from the processor U23 (Circuit diagram 15674-20-S1/.. Page 2). This signal is evaluated accordingly in the address decoder U26.

Address Decoding

Refer to **Table 2-5.** (CS=chip select signal)

The program memory U25 is accessed directly with the CPU signal /PSEN in the address range 0000H to FFFFH. The internal address ranges of the CPU's on-chip data RAM and XRAM are:

TABLE 2-5 ADDRESS DECODING

Designation	Signal Name	Address
CS U27 Data Memory	/CS_DATA	0000H to 1FFFH
CS U24 Configuration switch reading	/RD_CS	F000H
CS MOD1 Optocoupler input module 1 (Circuit Diagram 15674-20-S1/.. Page 4)	/CS_IN1	F200H
CS MOD1 Optocoupler input module 2 (Circuit Diagram 15674-20-S1/.. Page 4)	/CS_IN2	F300H

On-chip data RAM of the CPU (256 x 8):	00H to FFH
On-chip XRAM of the CPU (2K x 8):	F800H to FFFFH

5 V POWER FAIL AND RESET LOGIC

(Circuit Diagram 15674-20-S1-S1/.. Page 2)

When the +5 V supply voltage is turned ON, the component U20 (MAX700) generates a reset signal for the CPU (/RESET_POWER).

During operation, U20 monitors the +5 V supply voltage. If the +5 V supply voltage drops below a value of 4.7 V, then this will also generate a reset signal. A deliberate reset can be generated from an external source through the jumper JP6.

In the following reset logic, the /RESET_POWER signal from U20 and the CPU (U23) reset output /RO are set to OR through the diodes CR60 and CR61.

From this signal, the signal /RESET (active LOW) is then generated with the 4049 inverters U32A and U32B.

+15 V and -UOPV POWER FAIL LOGIC

(Circuit Diagram 15674-20-S1/.. Page 2)

The component U21 (MAX7665) monitors the +15V and -Uopv supply of the analog circuits. If either one of these two voltages drops below the set reference level, a message is transmitted to the CPU U23. The signal /POWERFAIL_+15 (active_LOW) is generated when the +15 V supply is too low, and can be sensed by the CPU U23 at port P1.4. The signal /POWERFAIL_Uopv (active_LOW) is generated when -Uopv is too low, and can be sensed by the CPU U23 at port P1.0.

The reference level for -Uopv is determined by the resistances R71 and R73,

The reference level for +15V is determined by the resistances R72 and R74,

At present, the set reference level for +15 V is +14 V.

At present, the set reference level for -Uopv is -10 V.

DIGITAL INPUTS

(Circuit Diagram 15674-20-S1/.. Page 4)

All digital inputs to the collimator control from external sources are routed through the optocupler modules MOD1 and MOD2. The CPU has the capability of inputting the status of these signals directly via the data bus.

DIGITAL OUTPUTS

(Circuit Diagram 15674-20-S1/.. Page 5)

The digital outputs are controlled directly from the port outputs of the CPU U23 (Circuit Diagram 15674-20-S1/.. Page 2). Since "Active LOW" is being used, these signals are inverted through U3 and U5 (74HCT240) to control the open-collector driver components U2 and U4 (ULN2803).

The LED CR9 is controlled by the signal /CPU_ACTIVE (U5/pin18).

This signal is cyclically activated by the software, so that the LED flashes if the CPU is functioning ("vital sign").

ANALOG INPUTS

(Circuit Diagram 15674-20-S1/.. Page 6)

Positive analog signals are always routed through RC filters for decoupling to operational amplifiers wired as impedance transformers. As protection against voltages in excess of +15 V and against negative voltages, safety diodes are connected to the input of the operational amplifier. The output of the operational amplifier is connected to a voltage divider. This voltage divider serves the purpose of adapting the analog signal to voltage levels in the range of 0 to +5 V, which is compatible with the CPU. In addition, two 5.1 V Zener diodes are connected to protect the analog inputs (port 7 and port 8) of the CPU (U23).

The reference voltage (VAREF) for the A/D converter in the CPU is generated by the component U14 (MAX675) from the potentiometer supply voltage +10 V_Upot. VAREF can be adjusted with the potentiometer R26; the voltage must be within the permissible voltage range of +5V 5%.

PWM MOTOR CONTROL

(Circuit Diagram 15674-20-S1/.. Page 7)

Page 7 displays the block circuit diagram of the motor control, subdivided into transverse motor and longitudinal motor diagrams.

The motor end stages are released through U22D and U29A by the signal COLL_INHIBIT when the CPU output P4.6 is at "active LOW". The signal status is indicated by the LED CR75.

MOTOR, TRANSVERSE

(Circuit Diagram 15674-20-S1/.. Page 8)

The transverse motor is controlled by the dual power operational amplifiers U30. Both operational amplifiers of U30 are operated with the resistances R93 and R94 functioning as comparators. The motor speed is adjusted directly by the processor through pulse-width modulated (PWM) signals.

The signal PWM2 (CPU U23 port P4.2) for the direction of rotation MOTOR_TRANS+is inverted through the driver U28E (4049) and routed through the decoupling resistance R91 to the open-collector driver U29F (ULN2803).

The signal PWM3 (CPU U23 port P4.3) for the direction of rotation MOTOR_TRANS is inverted through the driver U28F (4049) and routed through the decoupling resistance R92 to the open-collector driver U29E (ULN2803).

The conversion of the 5 V PWM signal to the 24 V level required for the two operational power amplifiers is accomplished by the drivers U29E and U29F.

The operational power amplifiers are released by the signal COLL_INHIBIT with "active LOW".

MOTOR, LONGITUDINAL

(Circuit Diagram 15674-20-S1/.. Page 9)

The longitudinal motor is controlled by the dual power operational amplifiers U33. Both operational amplifiers of U33 are operated with the resistances R125 and R126 functioning as comparators. The motor speed is controlled directly by the processor through pulse-width modulated (PWM) signals.

The signal PWM0 (CPU U23 port P4.0) for the direction of rotation MOTOR_LONG+ is inverted through the driver U32A (4049) and routed through the decoupling resistance R123 to the open-collector driver U29G (ULN2803).

The signal PWM1 (CPU U23 port P4.1) for the direction of rotation MOTOR_LONG is inverted through the driver U32B (4049) and routed through the decoupling resistance R124 to the open-collector driver U29H (ULN2803).

The conversion of the 5 V PWM signal to the 24 V level required for the two operational power amplifiers is accomplished by the drivers U29G and U29H.

The operational power amplifiers are released by the signal COLL_INHIBIT with "active LOW".

POWER SUPPLY

(Circuit Diagram 15674-20-S1/.. Page 10)

The AC power supply is provided through the terminal points TB1/3 and TB1/4 (Circuit Diagram 15674-20-S1/.. Page 11). CR33 provides rectification, and the capacitors C17 and C18 provide smoothing. The resulting voltage is reduced to a regulated +24V by a switching control comprised of the components U6 (MC34167T), L1, L2, C14, C15, C16, C27, R7, R17, R18, CR12 and CR13.

The optocouplers and motors are operated on this +24 V voltage, which also serves as the supply for the other required voltages:

From 24 V, the linearizing control U7 (7815) generates +15 V.

From +15 V, the linearizing control U8 (7805) generates +5 V (Voc) to supply the processor and the other 5V logic circuits.

From +15 V, the linearizing control U9 (7805) generates the +10V_Upot reference voltage. This voltage is adjusted with the potentiometer R15.

From +15 V, the negative reference voltage -Uopv for the operational amplifier is generated by means of a DC/DC converter consisting of the components U10 (4093), U36 (4093), R13, C26, C13, C12, CR11 and CR10.

All supply voltages are equipped with an LED as a status indicator:

CR15	+24 V
CR14	+5 V (Vcc)
CR18	+10 V_Upot
CR16	Uopv
CR17	+15 V

TERMINAL POINTS AND COLLIMATOR LIGHT BEAM CONTROL

(Circuit Diagram 15674-20-S1/.. Page 11)

The signals from/to the collimator control are routed through terminal points J3,J5,J7,J8.

The required supply voltages are provided through terminal strip TB1. The AC power of the electronics is provided through terminal points TB1/3 and TB1/4. The AC power of the collimator is provided through terminal points TB1/1 and TB1/2.

PE is supplied via the threaded/plug connection X1.

The collimator lamp is operated through the triac U13 (TW11N). The lamp is operated at full power by the signal LAMP_FULL (active LOW) and the optocoupler-triac U11 (MOC3040), through the triac U13. The lamp is operated at half power by the signal LAMP_HALF (active LOW), optocoupler-triac U12 (MOC3040) and diode CR21, through the triac U13.

K3 is actuated by the signal EXPOSURE _HOLD (active LOW), and the signal PBL (positive beam limitation), corresponding to the collimator setting, is routed to the generator.

DESCRIPTION OF CONNECTOR SIGNALS

(Circuit Diagram 15674-20-S1/.. Page 11)

The following electrical connections are required for operation of the collimator power supply:

a. Plug connector J3 for the acquisition of the cassette size in the Bucky table

b. Plug connector J5 for the acquisition of the source-image distance (SID)

c. Plug connector J7 for the generator control and, alternatively to connectors J3 and J5, acquisition of cassette size and of the source-image distance (SID).

d. Plug connector J8, collimator connection.

CAUTION

The potentiometers for cassette-size sensing and SID sensing are supplied with +10 V. The total load on the 10 V supply must not exceed 100 mA.

Signals Description, Plug Connector J3, Cassette Size Bucky Table (SUB-D 9-Pole Plug Connector)

J3-1	0 VDC return of +10V
J3-2	+10 VDC supply of potentiometers for cassette-size sensing
J3-3	Potentiometer arm cassette size longitudinal 0 V to +10 V The cassette size must be proportional to the voltage
J3-4	Potentiometer arm cassette size transverse 0 V to +10 V The cassette size must be proportional to the voltage
J3-5	Not used
J3-6	0 VDC when cassette is inserted in the Bucky table
J3-8	0 VDC return, cassette inserted
J3-9	PE
J3-Housing	PE

Signals Description, Plug Connector J5, SID Sensing (SUB-D 15-Pole Plug Connector)

J5-1	0 VDC return of +10V
J5-2	+10 VDC supply potentiometer for SID sensing.
J5-3	Potentiometer arm sensing 0V to +10 V. The SID increase must be proportional to the voltage.
J5-4	Not used
J5-5	Not used
J5-6	Not used
J5-7	Not used
J5-8	Not used
J5-9	Not used
J5-10	Not used
J5-11	Not used
J5-12	Not used
J5-13	Not used
J5-14	0 VDC
J5-15	PE
J5-Housing	PE

Signals Description, Plug Connector J7 (SUB-D 37-Pole Plug Connector)

J7-1	0 VDC
J7-2	Not used
J7-3	Not used
J7-4	Not used
J7-5	Not used
J7-6	Not used
J7-7	NC contact relay K3 Exposure Hold (in normal operation K3 is not actuated)
J7-8	Common contact relay K3 Exposure Hold (PBL)
J7-9	Not used
J7-10	Generator prep O VDC (turn collimator OFF)
J7-11	Not used
J7-12	Not used
J7-13	0 VDC of + 10 V
J7-14	+ 10 supply, potentiometers
J7-15	Table Longitudinal cassette size pot wiper 0 V to +10 V
J7-16	Table Transverse cassette size pot wiper 0 V to +10 V
J7-17	0 VDC when cassette is inserted in Bucky table
J7-18	Not used
J7-19	Not used
J7-20	Not used
J7-21	Potentiometer arm SID sensing O VDC to + 10 VDC (ceiling or column tube stand)
J7-22	Not used
J7-23	Not used
J7-24	Not used
J7-25	Not used
J7-26	Not used
J7-27	Not used
J7-28	Not used
J7-29	Not used
J7-30	Not used
J7-31	Not used
J7-32	Not used
J7-33	Not used
J7-34	Not used
J7-35	Not used
J7-36	Not used
J7-37	PE20

Signals Description, Plug Connector J8, Collimator (SUB-D 37-Pole Plug Connector)

J8-1	0 VAC return, collimator light
J8-2	0 VAC return, collimator light
J8-3	24 VAC supply collimator light switched
J8-4	24 VAC supply collimator light switched
J8-5	Matrix V1 (0 VDC return, "Manual" key and "Collimator Light" key)
J8-6	Matrix H1 ("Manual" key 0 VDC)
J8-7	Matrix H3 (tube unit direction vertical 0 VDC)
J8-8	Not used
J8-9	Not used
J8-10	Collimator motor longitudinal
J8-11	Collimator motor transverse
J8-12	Not used
J8-13	Yellow LED Manual 0 VDC
J8-14	Not used
J8-15	+24 V supply LEDs, direction sensing
J8-16	0 VDC return of 10 VDC
J8-17	Potentiometer arm collimator longitudinal 0 V to +10 V
J8-18	Potentiometer arm collimator transverse 0 V to +10 V
J8-19	Not used
J8-20	0 VAC return collimator light
J8-21	0 VAC return collimator light
J8-22	24 VAC supply collimator light switched
J8-23	24 VAC supply collimator light switched
J8-24	Not used
J8-25	Matrix H2 ("Collimator" key 0 VDC)
J8-26	Not used
J8-27	Not used
J8-28	Not used
J8-29	Collimator motor transverse +
J8-30	Collimator motor transverse
J8-31	Green LED Automatic 0 VDC
J8-32	Red LED Exposure Hold
J8-33	Not used
J8-34	+10 VDC supply collimator potentiometers
J8-35	0 VDC return
J8-36	PE
J8-37	PE
J8-Housing	PE

COLLIMATOR HEAD

COLLIMATOR FIELD LAMP

The collimator is equipped with a quartz iodide field lamp. The field lamp projects a visible center mark that corresponds to the center of the X-ray beam (within 2% of the SID). The center of the light field is projected onto the subject by the shadow of two perpendicular lines that are silk-screened onto the lexan window through which the light beam passes. This provides the operator with a direct visualization of the area targeted for the X-ray image.

The field light is activated by pressing the front panel membrane switch marked by the light symbol. Once the light is activated it will remain on for 30 seconds before turning off automatically. The average illumination is not less than 160 lux (16 footcandles) and the edge contrast ratio is four to one.

This lamp, when replaced, should never be touched with your fingers. In the first place, an operating lamp and surrounding parts are very hot and there is a danger of getting burnt. Secondly, touching the lamp will contaminate it with skin oil and may cause the lamp to break. If touched, the lamp must be cleaned with alcohol and dried with a clean soft cloth. The lamp is on a timer circuit to extend its life.

WARNING

NEVER LOOK DIRECTLY AT AN OPERATING LAMP. TURN POWER OFF BEFORE SERVICING. BRIGHT LIGHT AND/OR HIGH TEMPERATURES MAY CAUSE EYE INJURY OR BURNS TO SERVICE PERSONNEL.

ALIGNMENT AND CALIBRATION

INTRODUCTION

This section contains the alignment, calibration and adjustment procedures needed to set the collimator head and the collimator control for proper operation.

SPECIAL TOOLS AND EQUIPMENT

1. A large and a small cassette for calibration.
2. X-ray Film 14 x 17 inch
3. Film Processor
4. Light Field Alignment Template, E-59198A
5. Digital Multimeter (DMM)

Tools and equipment which are required for individual tests are listed before each test. These tools as listed or suitable substitutes must be used for these tests they are the responsibility of the customer and/or the service organization.

SAFETY

Service personnel are cautioned to observe all **CAUTIONS** and **WARNINGS** as they appear in the text. Failure to comply may result in bodily injury to service personnel.

COLLIMATOR ALIGNMENT

WARNING

X-RADIATION WILL BE PRODUCED DURING THE FOLLOWING PROCEDURE. WEAR PROTECTIVE GLOVES AND APRON. CLEAR THE AREA OF UNNECESSARY PERSONNEL OR USE RADIATION BARRIERS DURING RADIATION EXPOSURES. FAILURE TO COMPLY CAN CAUSE SERIOUS INJURY TO ATTENDANT PERSONNEL.

ALIGNMENT TO THE X-RAY BEAM

The following procedure must be performed at installation, every 6 months and anytime that the collimator to X-ray tube positioning adjustment are moved such as after removing and replacing the collimator from the X-ray tube.

1. Place a loaded 10 x 12 inch (24 x 30 cm) or larger cassette on the tabletop centered on the scribed centerline (not critical).

2. Outline the cassette accurately using masking tape so that the cassette can be repositioned in exactly the same position at a later time.

3. Place the center of the alignment template E-59198A on the center of the cassette with all four edges parallel with the edges of the cassette. Tape the template on top of the cassette.

   The pattern on the template is radiopaque and will appear on the processed film after exposure. Front and rear, left or right sides can be determined by template's numbering scale.

4. Using a tape measure, position the X-ray tube/collimator assembly for a 40" SID.

5. Press the FIELD LITE switch to ON. Center the collimator directly over the template so the light field cross hairs are coincident with the center of the template pattern.

6. Adjust the shutters until the light field just fills the 6 x 6 inch (15.2 x 15.2 cm) square pattern on the template.

7. Set the technique factors at the X-ray generator to produce a density of about 1 (about 50kV, 5mAs).

8. Make an exposure and develop the film.

   The exposed film will be used to check for the following adjustments that are described in turn in the following procedures:

   a. COLLIMATOR TO FOCAL SPOT ALIGNMENT (PRIMARY SHUTTER CUTOFF)

   b. LIGHT FIELD TO X-RAY FIELD ALIGNMENT

   c. FIELD SIZE INDICATION ADJUSTMENT

   d. BUCKY LIGHT LINE ADJUSTMENT

   e. CROSSHAIRS ALIGNMENT

   f. FRICTION BRAKE ADJUSTMENT

   g. MECHANICAL MOTION STOP ADJUSTMENT

COLLIMATOR TO FOCAL SPOT ALIGNMENT (PRIMARY SHUTTER CUTOFF)

1. Inspect the edges of the image on the film (the edges are formed by the four collimator shutters).

   If any edge is fuzzy and not well-defined, it indicates that the image is being shaped by the primary shutter which is closest to the focal spot rather than the outermost shutter as it should be.

   To correct the condition, use the four mounting/centering adjustment screws (shown in **Figure 3-1**) to shift the collimator in the direction of the fuzzy edge.

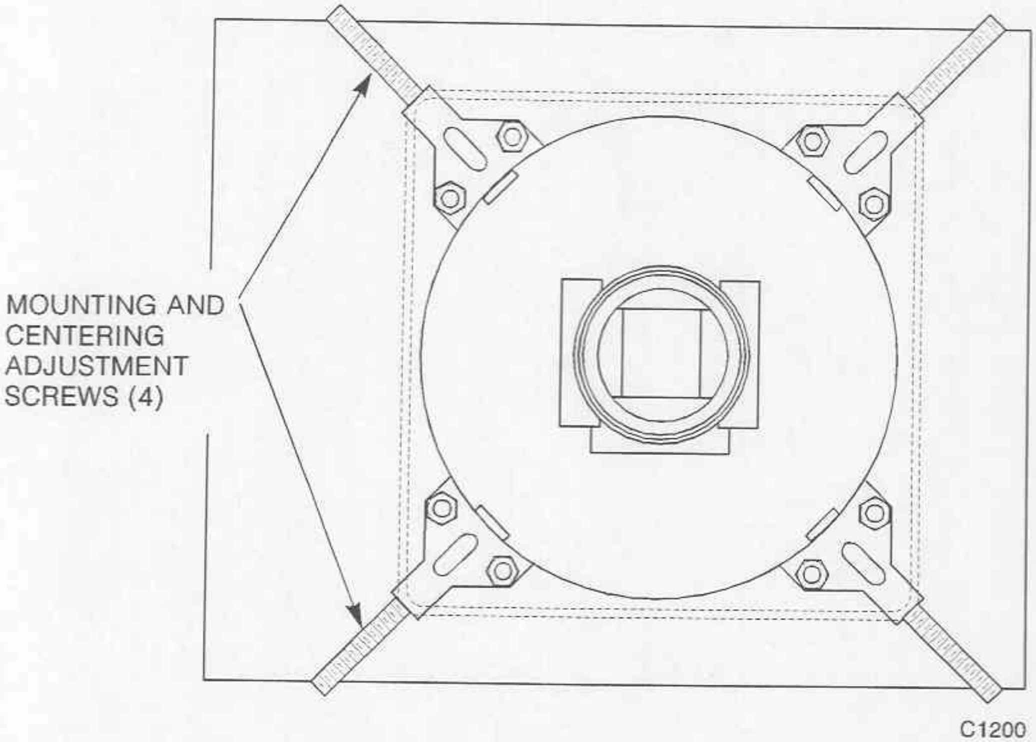


FIGURE 3-1 COLLIMATOR POSITION ADJUSTMENTS

2. Repeat the test film exposure after making the adjustment.

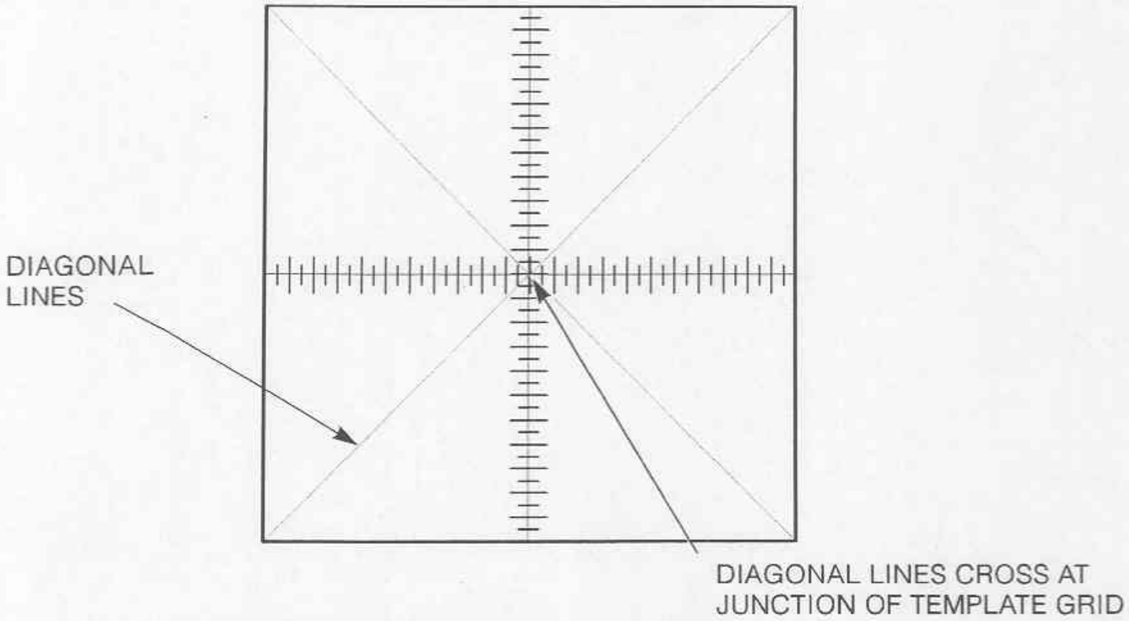
NOTE

Because of the heal effect, the field toward the cathode will be slightly less sharp than the other three sides. This is normal and cannot be corrected by adjustment. In addition, an X-ray tube with a target angle of 12 degrees or less will produce an asymmetrically shaped field when a large field size is used with a short SID because of the anode cutoff effect. This is normal and may not be corrected by adjustment.

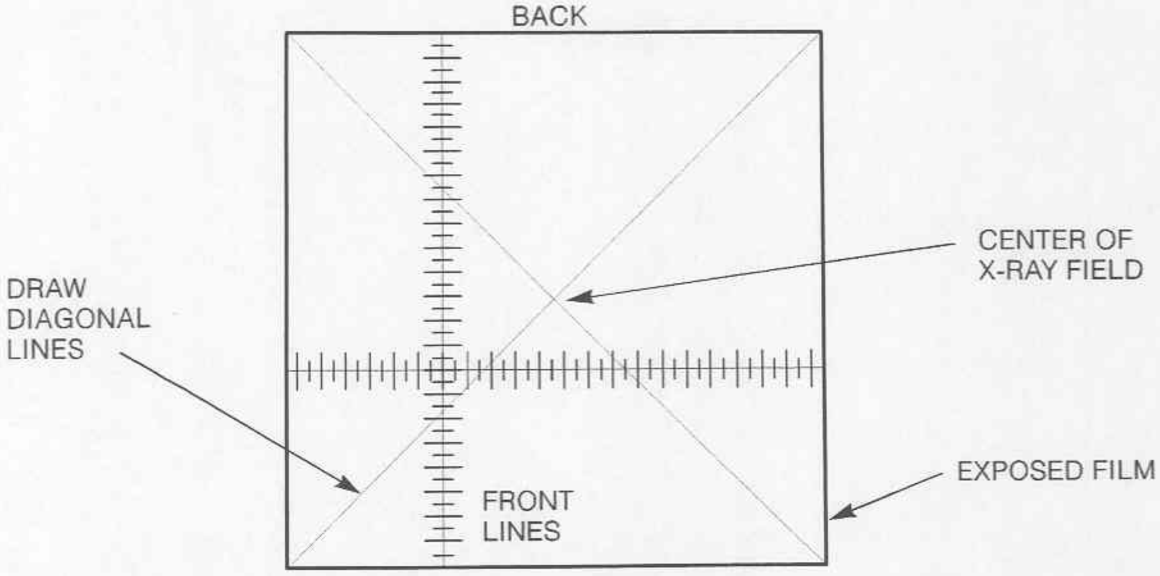
LIGHT FIELD TO X-RAY FIELD ALIGNMENT

The regulations state that the total misalignment of the light fields to the X-ray field in either the transverse or longitudinal direction must be less than 2% of the SID. In this case, the misalignment must not exceed about 3/4". To determine the alignment proceed as follows:

1. On the film, draw diagonal lines connecting corners of the exposed X-ray field as shown in **Figure 3-2**.


DIAGONAL
LINES
DIAGONAL LINES CROSS AT
JUNCTION OF TEMPLATE GRID

PROPER ALIGNMENT OF FIELDS


BACK
CENTER OF
X-RAY FIELD
DRAW
DIAGONAL
LINES
EXPOSED FILM
FRONT
LINES

IMPROPER ALIGNMENT OF FIELDS

C1201

FIGURE 3-2 LIGHT FIELD TO X-RAY FIELD ALIGNMENT

2. Measure the distance between the intersection of the diagonal lines (center of X-ray field) and the junction of the two graduated template pattern lines (center of light field) as shown in **Figure 3-2**.

   If the test film shows that the transverse or longitudinal misalignment between the light field center and the X-ray field center is less than 3/4" then the alignment complies with the regulations.

   However, the tolerance of misalignment allowed by the regulation is quite large and in general a much better alignment should be obtained. The recommended maximum deviation is 1/8". If there is less than 1/8" misalignment in both directions, skip to step 6 for light field sizing.

3. If the collimator mount spacing is correct, but adjustment is still required, **DO NOT MOVE THE COLLIMATOR RELATIVE TO THE X-RAY TUBE** (as was done previously) but proceed as follows:

   a. Place the cassette in its original marked position on the table top and place the white paper and test film on the face of the cassette (make sure that the film is oriented correctly according to the orientation coins).

   b. Using the images of the collimator shutters as the reference for the shape and size of the X-ray field, adjust the light field to be centered to it.

      To move the light field in the transverse direction:

      i. Remove the plastic plug from the right side of the collimator as shown in **Figure 3-3.**

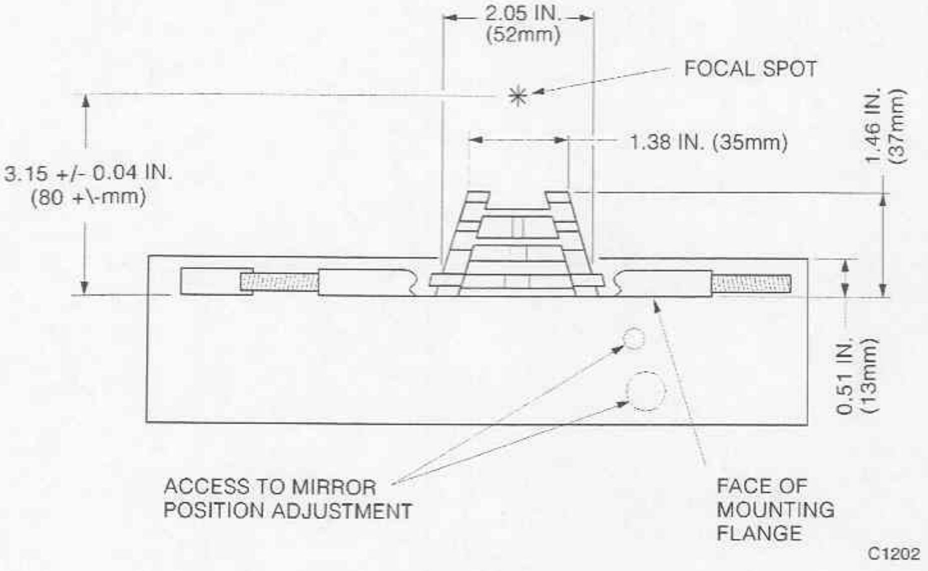

2.05 IN.
(52mm)
FOCAL SPOT
1.38 IN. (35mm)
1.46 IN.
(37mm)
3.15 +/- 0.04 IN.
(80 +\-mm)
0.51 IN.
(13mm)
ACCESS TO MIRROR
POSITION ADJUSTMENT
FACE OF
MOUNTING
FLANGE
C1202

FIGURE 3-3 COLLIMATOR SPACING

ii. Loosen the cam locking screw enough to permit rotating the adjustor cam (see **Figure 3-**4)

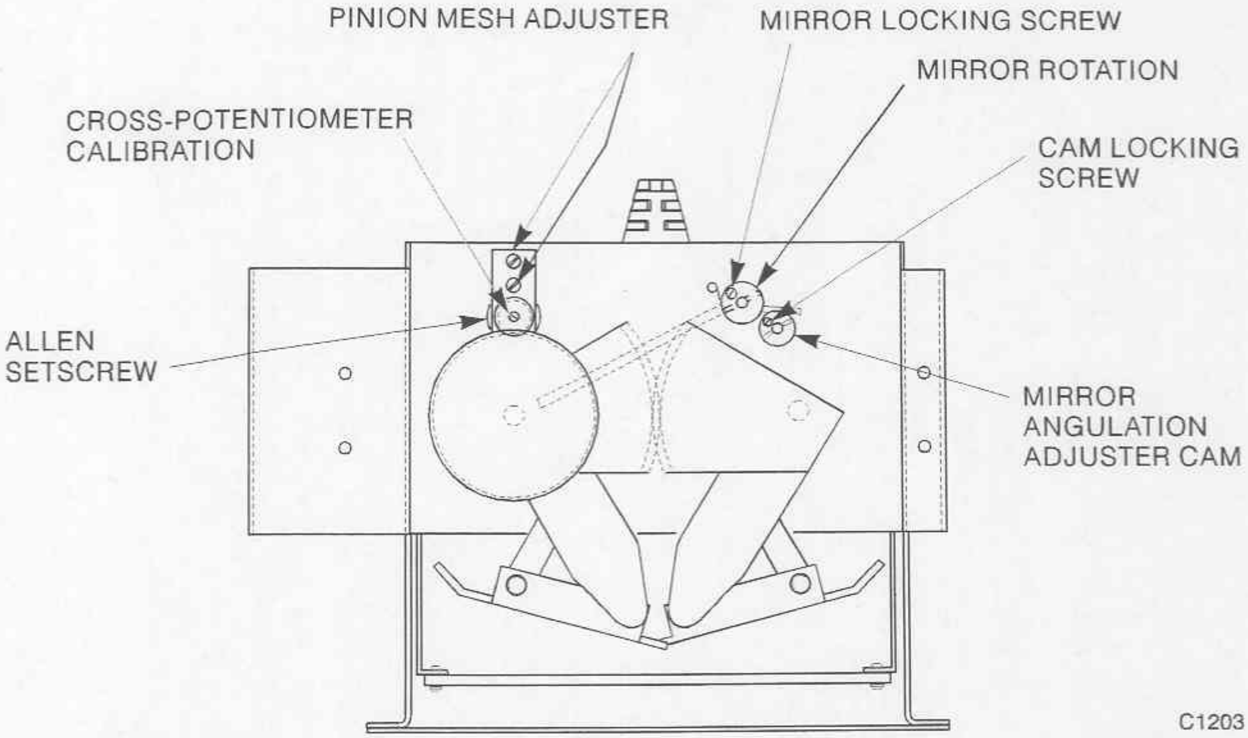

PINION MESH ADJUSTER
MIRROR LOCKING SCREW
MIRROR ROTATION
CROSS-POTENTIOMETER
CALIBRATION
CAM LOCKING
SCREW
ALLEN
SETSCREW
MIRROR
ANGULATION
ADJUSTER CAM
C1203

FIGURE 3-4 TRANSVERSE FIELD LIGHT ADJUSTMENT

iii. Lock the cam into position after adjusting the mirror position and replace the access plug.

4. If longitudinal adjustment is required, **DO NOT MOVE THE COLLIMATOR RELATIVE TO THE X-RAY TUBE** (as was done previously) but proceed as follows:

   a. Place the cassette in its original marked position on the table top and place the white paper and test film on the face of the cassette (make sure that the film is oriented correctly according to the orientation coins).

   b. Using the images of the collimator shutters as the reference for the shape and size of the X-ray field, adjust the light field to be centered to it.

   To move the light field in the longitudinal direction:

   i. Remove the cover from the rear of the collimator.

   ii. Loosen the two screws holding the lamp bracket and move it as required to position the light field.

WARNING

DO NOT TOUCH THE LAMP OR THE LAMP BRACKET. THE LAMP AND BRACKET CAN GET VERY HOT AND MAY CAUSE SEVERE BURNS.

CAUTION

DO NOT TOUCH THE LAMP, EVEN WHILE IT IS COOL. SKIN OIL WILL CAUSE THE LAMP TO CRACK AND POSSIBLY BURST.

If you touch the lamp, wash it off with alcohol. When handling the lamp, use paper, cloth or some other material to keep skin from contacting the lamp.

5. After the light field and exposure field are aligned to each other, adjust them to be the same size.

   To adjust the size of the light field to match the exposure field, loosen the two screws holding the socket to the bracket (see **Figure 3-5**) and move the socket and the lamp up or down as required until the field sizes match.

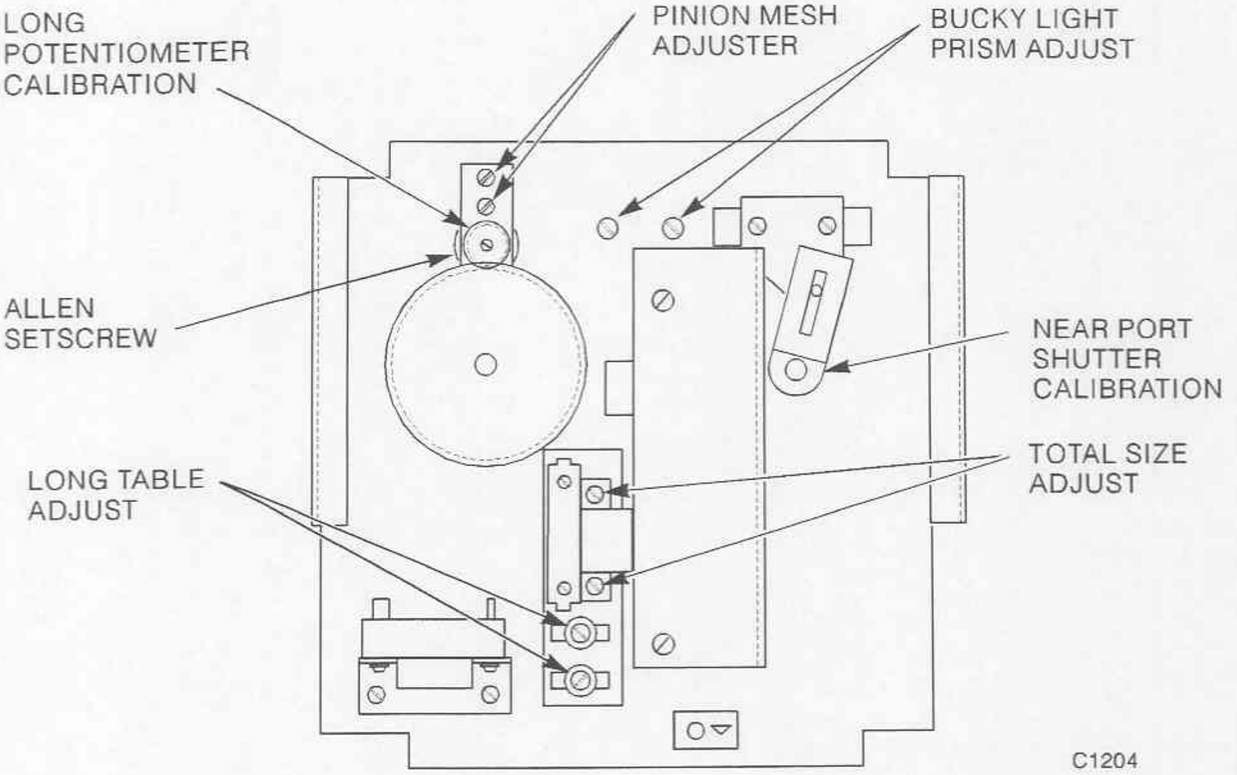

LONG
POTENTIOMETER
CALIBRATION
PINION MESH
ADJUSTER
BUCKY LIGHT
PRISM ADJUST
ALLEN
SETSCREW
NEAR PORT
SHUTTER
CALIBRATION
LONG TABLE
ADJUST
TOTAL SIZE
ADJUST
C1204

FIGURE 3-5 LIGHT FIELD TOTAL SIZE ADJUSTMENT

6. Repeat the test film exposure after the adjustment has been made.

FIELD SIZE INDICATION ADJUSTMENT

The regulations state that the collimator must indicate the size of the X-ray field at the SID in use to within 2% of that SID. In this case, indication must be correct within 3/4". To check and adjust the dial indicators, proceed as follows:

Shutter Dial Pre-adjustment

1. Rotate the two control knobs to completely close both sets of shutters. Use the field light to ascertain that the shutters are in fact closed.

2. Look to see if each of the dial indicators is precisely over the dial line marked CLOSED. It is most probable that if the indicators show closed

when the shutters are closed, all the other dial indications will prove to be correct.

Shutter Dial Calibration:

1. Measure the size of the X-ray fields shown on the test film.
2. Adjust the light field to the same dimension and read the indication on the dial.

   If it does not read within 3/4" of the measured dimension of the light field, adjust the indicator as follows loosen the screw on the side of the knob and rotate it until it indicates correctly.

BUCKY LIGHT LINE ADJUSTMENT

1. Remove the collimator rear cover to gain access to the point of adjustment as shown in **Figure 3-6**.
2. To focus the line, set the SID to 40" and move the light line shield up or down as required to obtain the sharpest line.
3. The bucky light line should fall on a perpendicular bisector line constructed against the plastic dust cover toward the control face of the collimator.

   If it does not, adjust the position of the line using the light prism adjusting screws indicated in **Figure 3-6**. Note that the prism and bracket are inside the collimator frame and cannot be seen, but may be controlled by the two securing screws indicated in the figure.

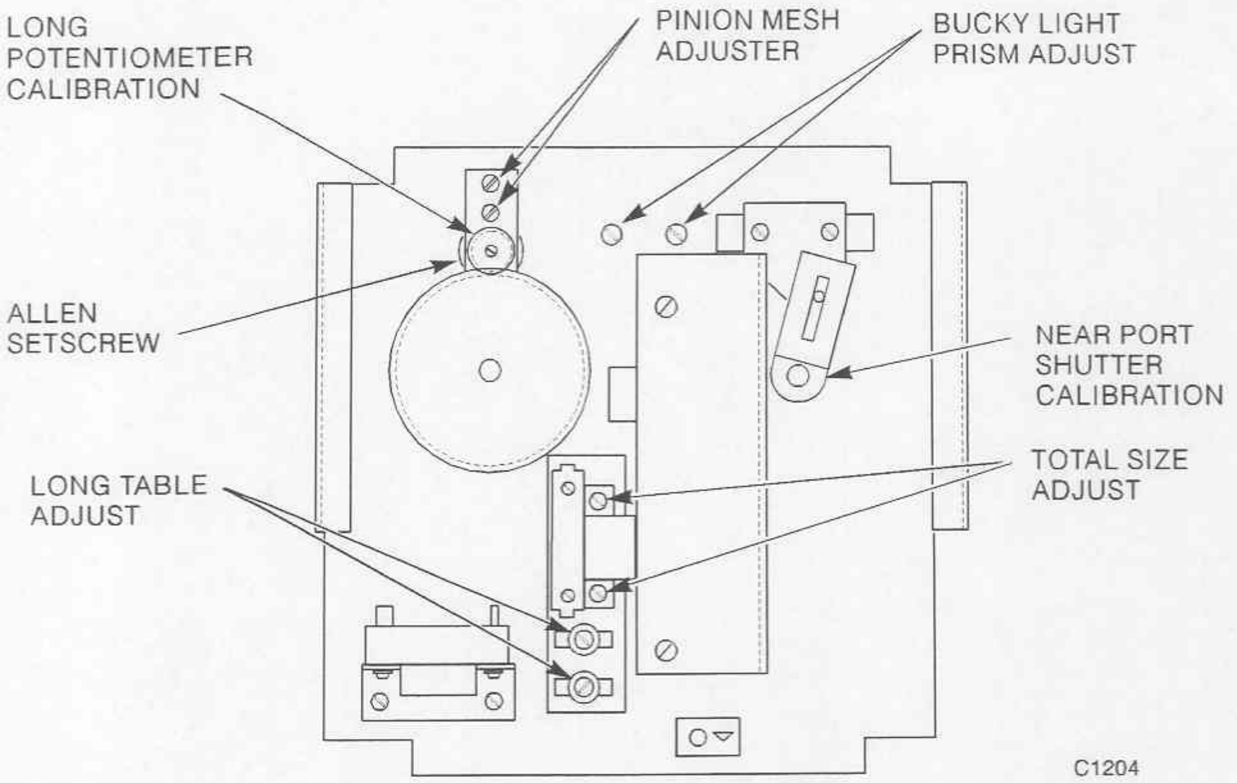

LONG POTENTIOMETER CALIBRATION
PINION MESH ADJUSTER
BUCKY LIGHT PRISM ADJUST
ALLEN SETSCREW
NEAR PORT SHUTTER CALIBRATION
TOTAL SIZE ADJUST
LONG TABLE ADJUST
C1204

FIGURE 3-6 BUCKY LIGHT PRISM ADJUSTMENT

CROSSHAIRS ALIGNMENT

1. Activate the light field.
2. Turn the control knobs to bring the light field to a narrow line, each direction in turn.
3. Look to see that the crosshair lines are centered in the narrow light lines in each direction.

   If adjustment is required, remove the cover from the sides and bottom of the collimator to gain access to th adjustments. Loosen the four screws securing the plastic panel to the collimator frame and position the plate to center the crosshairs in the light lines.

FRICTION BRAKE ADJUSTMENT

The friction brake needs adjustment if the shutters do not move when the shutter motor runs or if the shutter knob is difficult to turn. If one of these symtoms is present, proceed as follows:

1. Close both shutters and note that both dials indicate zero.
2. Remove the collimator face plate to gain access to the brake adjustment.
3. Adjust the appropriate friction brake (see **Figure 3-7**) to obtain the optimum friction.
4. Reinstall the face plate and the control knobs, After the knobs are replaced, the indicator must be adjusted to correctly show the field size.

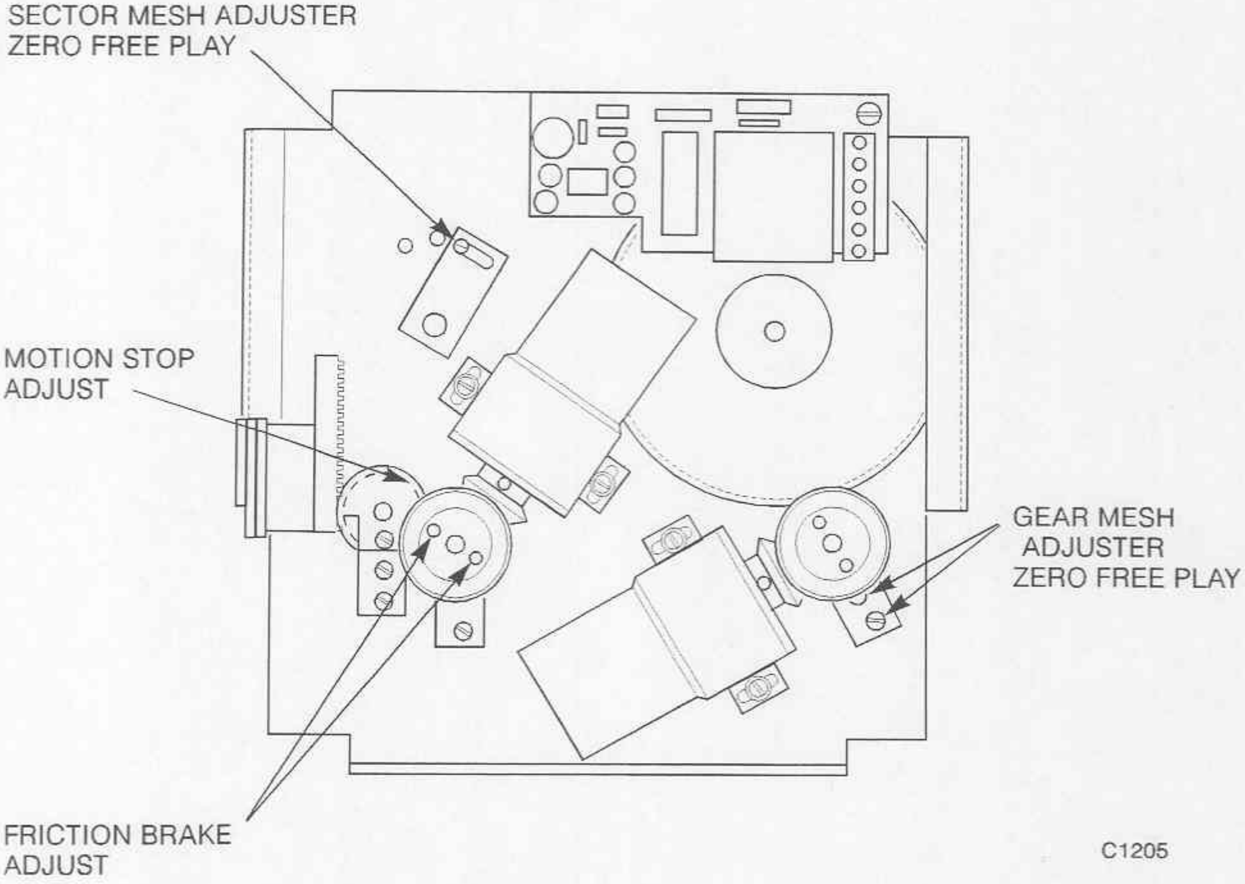

SECTOR MESH ADJUSTER
ZERO FREE PLAY
MOTION STOP
ADJUST
GEAR MESH
ADJUSTER
ZERO FREE PLAY
FRICTION BRAKE
ADJUST
C1205

FIGURE 3-7 SHUTTER ADJUSTMENTS

MECHANICAL MOTION STOP ADJUSTMENT

The purpose of the shutter stops is to prevent the over stressing of the shutters control linkage at the two extremities of travel by limiting the rotation of the control shafts.

Adjustment of these stops will not be required unless:

1. The shutters cannot be closed or opened to the largest size.
2. A resistance is felt at one or both extremes of the travel. (This indicates that the shutters themselves are acting to limit the motion rather than the stops.)

To set the CLOSED stop:

1. Loosen the socket-head screw on the side of the stop as indicated in **Figure 3-7**.
2. Temporarily remount the shutter control knob.
3. Turn the field light on and close the shutters until the field light indicates that they are closed. Be careful to use only just enough pressure close the shutters.
4. Adjust the stop until it just begins to open the shutter.
5. Tighten the adjusting screw.
6. Open and close the shutters several times and check that the shutters close fully just as the cam can be felt to strike the stop.

CONTROL UNIT PROGRAMMING

INTRODUCTION

The required programming functions are selected by setting the appropriate DIP-switch positions, S1-1 to S1-8 (**Table 4-1**).

The following programming functions must be performed in the order listed:

- Programming of the minimum and maximal aperturesof the collimator vanes
- Programming of the minimum SID for automatic operation
- Programming of the maximum SID for automatic operation
- Programming of the SID compensation
- Programming of cassette sizes
- Saving the program data to the EEPROM

Programming of cassette sizes or programming of the SID compensation can be performed repeatedly without affecting other programmed settings. Programming of the minimal aperture of the collimator vanes affects the cassette size calibration. Programming of the minimum SID for automatic operation affects the SID compensation.

Programming is performed by using the collimator light field to represent the X-ray field. Therefore the light field must be precisely aligned with the X-ray beam before programming is performed.

Alignment drawing 1342:1 (included with table schematics and drawings) makes the calibration easier because it can be placed on the tabletop. The film size outlines on the alignment drawing are not full size. The drawing outlines are drawn to the size that the X-ray field (represented by the light field) should be at tabletop level to properly expose the size of film indicated on the drawing.

The selection of a programming function is identified by flashing of the yellow LED "Manual" and the red LED "Exposure Hold" at the collimator control panel.

Flashing of only the red LED "Exposure Hold" indicates that the service mode has been selected. In this mode of operation, no programming or SID compensation can be performed.

TABLE 4-1 PROGRAMMING FUNCTIONS

S1-1	S1-2	S1-3	S1-4	S1-5	S1-6	S1-7	S1-8	FUNCTION
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	Normal operation
ON	OFF	OFF	OFF	OFF	OFF	OFF	OFF	Service mode
ON	ON	OFF	OFF	OFF	OFF	OFF	OFF	Programming min/max collimator aperture
ON	ON	ON	OFF	OFF	OFF	OFF	OFF	Programming SIDmin
ON	ON	ON	ON	OFF	OFF	OFF	OFF	Programming SIDmax
ON	OFF	ON	OFF	OFF	OFF	OFF	OFF	Programming SID compensation
ON	OFF	OFF	ON	OFF	OFF	OFF	OFF	Programming cassette sizes
ON	OFF	ON	OFF	ON	OFF	ON	OFF	Saving programmed data to the EEPROM

EVALUATING CALIBRATION ERRORS

If the cassette size calibration is inaccurate at the minimum SID, then the programming of cassette sizes may be repeated. If the cassette size coverage is correct at the minimum SID, but is insufficient at the maximum SID, then the programming of the SID compensation may be repeated.

PROGRAMMING DURING INITIAL INSTALLATION OR RECALIBRATION

Adhere to the following sequence:

1. Programming of the minimal and maximal collimator apertures
2. Programming of the minimum SID for automatic operation
3. Programming of the maximum SID for automatic operation.
4. Programming of the SID compensation.
5. Programming of cassette sizes.
6. Saving the program data to the EEPROM.

PROGRAMMING

PROGRAMMING MINIMUM AND MAXIMUM COLLIMATOR APERTURES

Set the control to program the aperture limits by setting DIP switch S1 sections S1-1 and S1-2 ON, and S1-3 through S1-8 OFF. The yellow and red indicators will flash to indicate that the control unit is in the programming mode.

The programming sequence of the minimum and maximum collimator aperture is arbitrary.

Set the longitudinal and transverse collimator vanes to their smallest aperture (i.e. closed). The green LED ("Automatic ") at the collimator control panel must now illuminate. If the LED is switched off, then *both* sets of collimator vanes are not closed. To program, actuate the Manual key at the control panel. As verification, the yellow LED ("Manual") illuminates for 2 seconds. Follow the same procedure for programming the maximum aperture of the collimator vanes.

If the green LED ("Automatic") flashes for 5 seconds after programming the minimum and the maximum collimator aperture, then the programmed value for the minimum collimator aperture is greater than the value for the maximum collimator aperture. If this is the case, measure the voltage at TP68 (longitudinal) or TP70 (transverse) at the maximum and minimum collimator vane positions. The voltage must be greater than 3.5 V for the maximum collimator aperture and less than 3.5 V for the minimum collimator aperture.

If no further programming is required, proceed according to "Saving the Programmed Data to the EEPROM".

PROGRAMMING MINIMUM SID

Set DIP switches S1-1 through S1-3 ON, and DIP switches S1-4 through S1-8 OFF. The red and yellow indicators should flash to indicate the programming mode.

Move the X-ray tube unit to the desired minimum SID (90 cm). To program, actuate the Manual key at the control panel. As verification, the yellow LED ("Manual") illuminates for 2 seconds.

If the green LED ("Automatic") flashes for 5 seconds after programming, then the programmed value for the minimum collimator aperture is greater than or equal to the value for the maximum collimator aperture. To make the correction, reprogram either the minimum SID or the maximum SID.

If no further programming is required, proceed according to "Saving the Programmed Data to the EEPROM".

PROGRAMMING MAXIMUM SID

DIP switches S1-1 through S1-4 ON, DIP switches S1-5 through S1-8 OFF.

Move the X-ray tube unit to the maximum SID possible (approximately 117 cm). To program, actuate the "Manual" key at the control panel. As verification, the yellow LED ("Manual") illuminates for 2 seconds.

If the green LED ("Automatic") flashes for 5 seconds after programming, then the programmed value for the maximum collimator aperture is smaller than or equal to the value for the minimum collimator aperture. To make the correction, reprogram either the maximum SID or the minimum SID.

If no further programming is required, proceed according to "Saving the Programmed Data to the EEPROM".

PROGRAMMING THE SID COMPENSATION

Set DIP switches S1-1 and S1-3 ON, DIP switches S1-2 and S1-4 through S1-8 OFF.

The sequence of starting the programming either with the minimum or with the maximum SID is arbitrary. The important objective in this programming task is to achieve constant field size at the minimum and maximum SID.

Programming is possible only when the green LED ("Automatic") at the collimator control panel illuminates. This occurs when the following conditions are met:

- The minimum and maximum apertures of the collimator vanes have been programmed.
- The minimum and maximum SIDs for automatic operation have been programmed.
- Insert a cassette of any desired size (e.g. 18 x 24 cm).

Move the X-ray tube unit to the minimum SID. The green indicator should light.

Adjust the longitudinal and transverse collimator vanes to an arbitrary field size (e.g. 18 x 24 cm) according to the alignment drawing 1342:1. To program the control, actuate the Manual key at the control panel. As verification, the yellow LED ("Manual") illuminates for 2 seconds.

Move the X-ray tube unit to the maximum SID. Adjust the longitudinal and transverse collimator vanes to the same field size used the first time at the minimum SID. To program, actuate the Manual key at the control panel. As verification, the yellow LED ("Manual") illuminates for 2 seconds.

If the green LED ("Automatic") flashes for 5 seconds after the programming, then the SID compensation has not been correctly programmed. The collimator aperture for the minimum SID must always be larger than the collimator aperture for the maximum SID. Reprogram the SID compensation.

If no further programming is required, proceed according to the section entitled "Saving the Programmed Data to the EEPROM".

PROGRAMMING CASSETTE SIZES

DIP switches S1-1 and S1-4 ON, DIP switches S1-2 and S1-5 through S1-8 OFF.

The sequence of starting the programming either with the smallest or with the largest cassette size is arbitrary. Two different cassette sizes must programmed.

Programming is possible only when the green LED ("Automatic") at the collimator control panel illuminates. This occurs when the following conditions are met:

- The minimum and maximum apertures of the collimator vanes have been programmed.
- The minimum and maximum SIDs for automatic operation have been programmed.
- Insert the cassette.
- Move the X-ray tube unit to the minimum SID.

Insert the smallest possible cassette size to be used. Move the X-ray tube unit to the minimum SID. Using the collimator light beam, adjust the longitudinal and transverse collimator vanes to the size of the inserted cassette, e.g. 18 x 24 cm. To program, actuate the Manual key at the control panel. As verification, the yellow LED ("Manual") illuminates for 2 seconds.

Insert the largest possible cassette size to be used. Using the collimator light beam, adjust the longitudinal and transverse collimator vanes to the size of the inserted cassette. To program, actuate the Manual key at the control panel. As verification, the yellow LED ("Manual") illuminates for 2 seconds.

If the green LED ("Automatic") flashes for 5 seconds after the programming, then both cassettes have been detected to be of the same size during the cassette size programming. Reprogram the cassette sizes.

If no further programming is required, proceed according to "Saving the Programmed Data to the EEPROM".

SAVING PROGRAM DATA TO THE EEPROM

Set the DIP switches S1-1, S1-3, S1-5 and S1-7 ON.

To save the programmed data, actuate the Manual key at the control panel. As verification, the yellow LED ("Manual") illuminates for 2 seconds. Set the DIP switches S1-1, S1-3, S1-5 and S1-7 OFF.

If all programming tasks have been completed, the DIP switches S1-1 through S1-8 must be in the OFF position for normal collimator operation.

TROUBLESHOOTING

ERROR MESSAGES

Error messages can be displayed only during normal operation, when the DIP switches S1-1 through S1-8 are all in the OFF position. An error has been detected if the red LED ("Exposure Hold") at the control panel is flashing. The type of error is identified by the yellow LED ("Manual") and green LED ("Automatic") at the control panel. The errors indicated are listed in **Figure 5-1**.

TABLE 5-1 ERROR INDICATIONS

Automatic Green LED	Manual Yellow LED	Exposure Hold Red LED	Indicated Problems
Illuminates	Illuminates	Flashes	-Uopv supply defective. See page 2-7.
Illuminates	Flashes	Flashes	+15 V supply defective. See page 2-7.
Flashes	Illuminates	Flashes	+10 V supply, TP56 not within 8 to 12 V. Adjust to 10.0 V with R15. The corresponding voltage range at TP61 must be within 2 to 3 V
Flashes	Flashes	Flashes	Motor ON time exceeded. No calibration attainable in the automatic mode.
Flashes	OFF	Flashes	Not all programming tasks completed. Perform programming tasks as described on page 4-1.
Flashes	OFF	Flashes	Program restart by watchdog failure. System will automatically reset in 5 sec. Only one reset will be attempted if the condition that caused the problem persists,

MAINTENANCE

COMPLIANCE MAINTENANCE

A program of planned maintenance must be established in order to ensure the continued safe performance and compliance of the collimator and associated X-ray equipment. As noted in (FDA) 75-8005, A PRACTITIONER'S GUIDE TO THE DIAGNOSTIC X-RAY EQUIPMENT STANDARD: "It is up to the practitioner to have his X-ray equipment maintained according to the schedule furnished by the manufacturer to insure compliance with the standard for the life of the equipment". Failure to follow the manufacturer's maintenance instructions could relieve the manufacturer of responsibility for continued compliance.

Maintenance procedures, necessary to ensure conformance to the manufacturer's specifications are contained in the User's Maintenance Schedule, given in **Table 6-1**. This maintenance should be performed by qualified trained service personnel at the prescribed intervals.

PLANNED MAINTENANCE

Planned maintenance requirements are also specified in the applicable User's Maintenance Schedule (**Table 6-1**). Planned maintenance consists of things that must be done to ensure the operation integrity and safety of the equipment. It is also the owner/user's responsibility to perform preventive maintenance at the specified intervals or arrange for such service with an authorized Service Office.

TABLE 6-1 USER'S MAINTENANCE SCHEDULE

ITEM	TIME INTERVAL	COMMENTS
OPERATOR TESTS:		
Leakage Radiation	1 mo.	Visually and manipulatively inspect the collimator and its attachment to the x-ray tube housing for physical damage, loose members, or wear which could affect the leakage radiation.
MECHANICAL/ELECTRICAL		
Routine Maintenance	6 mo.	1) Inspect internal moving parts for signs of wear and damage. 2) Clean the parts of the collimator including the plastic window. 3) Sparingly lubricate the moving parts with graphite oil. Wipe away all excess oil.
Power Supply Backup Batteries	6 mo.	Check charge. See procedure in this manual.
Electrical Calibration	6 mo.	Refer to calibration section of this manual.
Collimator Alignment	Note 1	Refer to calibration section of this manual.
SCHEDULED PARTS REPLACEMENT		
Power Supply Backup Batteries	5 yr.	

NOTE 1: Collimator alignment to the X-ray beam and light field to X-ray field alignment must be done every 6 months and anytime the collimator is removed from the X-ray tube. Light field to X-ray field alignment must also be done after collimator light replacement.

Replacing Components

Replacing the Collimator Control PCB

1. Create the following bridge configuration:

JP22		insert	(PBL_Interlock_Table)
JP5	in pos. 2-3	insert	(inhibit oscillator watchdog)
JP7	in pos. 2-3	insert	(softwre controlled watchdog release)
JP8	in pos. 2-3	insert	(program memory 32k x 8)
JP9	in pos. 1-2	insert	(data memory 2k x 8)
JP26		remove	(data memory 2k x 8)
JP27	in pos. 1-2	insert	(data memory 2k x 8)

2. A voltage of +10.0 V must be present at TP56 (+10 V_Upot).
   Reference point analog ground TP57.
   Adjust to 10.0 V with potentiometer R15.

3. If the replacement of the collimator PCB is not related to a defective EEPROM, then the EEPROM of the defective collimator PCB can be inserted into the new collimator PCB. Reprogramming of the collimator control is not required. Otherwise, proceed to program the collimator in accordance with the programming instructions in Section 4.

END OF MANUAL

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Installation Manual

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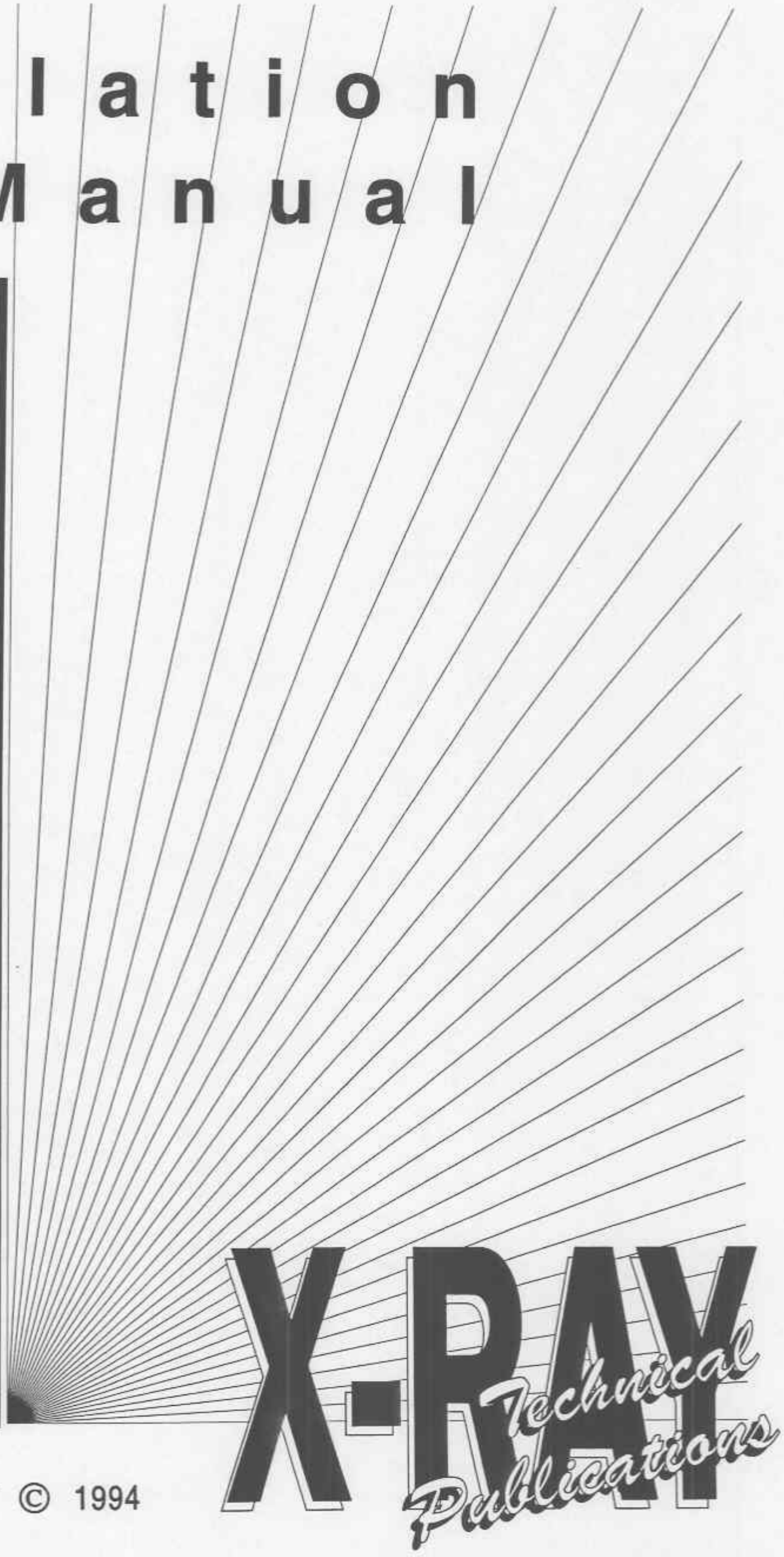

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NOTICE

The information contained in this manual conforms with the configuration of the equipment as of the date of manufacture. Revisions to the equipment subsequent to the date of manufacture will be addressed in service updates distributed to the Picker Technical Service Organization.

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Diagnostic X-ray Systems

MECHANICAL - ELECTRICAL WARNING

ALL OF THE MOVEABLE ASSEMBLIES AND PARTS OF THIS EQUIPMENT SHOULD BE OPERATED WITH CARE AND ROUTINELY INSPECTED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS CONTAINED IN THE EQUIPMENT MANUALS.

ONLY PROPERLY TRAINED AND QUALIFIED PERSONNEL SHOULD BE PERMITTED ACCESS TO ANY INTERNAL PARTS. LIVE ELECTRICAL TERMINALS ARE DEADLY; BE SURE LINE DISCONNECT SWITCHES ARE OPENED AND OTHER APPROPRIATE PRECAUTIONS ARE TAKEN BEFORE OPENING ACCESS DOORS, REMOVING ENCLOSURE PANELS, OR ATTACHING ACCESSORIES.

DO NOT REMOVE FLEXIBLE HIGH TENSION CABLES FROM X-RAY TUBE HOUSING OR HIGH TENSION GENERATOR AND/OR ACCESS COVERS FROM GENERATOR UNTIL THE MAIN AND AUXILIARY POWER SUPPLIES HAVE BEEN DISCONNECTED.

FAILURE TO COMPLY WITH THE FOREGOING MAY RESULT IN SERIOUS OR FATAL BODILY INJURIES TO THE OPERATOR OR THOSE IN THE AREA.

ELECTRICAL GROUNDING INSTRUCTIONS

THE EQUIPMENT MUST BE GROUNDED TO AN EARTH GROUND BY A SEPARATE CONDUCTOR. THE NEUTRAL SIDE OF THE LINE IS NOT TO BE CONSIDERED THE EARTH GROUND. ON EQUIPMENT PROVIDED WITH A LINE CORD, THE EQUIPMENT MUST BE CONNECTED TO A PROPERLY GROUNDED, THREE-PIN RECEPTACLE. DO NOT USE A THREE-TO-TWO PIN ADAPTER.

INSTALLATION AND ENVIRONMENT

EXCEPT FOR INSTALLATIONS REQUIRING CERTIFICATION BY THE MANUFACTURER PER FEDERAL STANDARDS, SEE THAT A RADIATION PROTECTION SURVEY IS MADE BY A QUALIFIED EXPERT IN ACCORDANCE WITH NCRP 102, SECTION 7, AS REVISED OR REPLACED IN THE FUTURE. PERFORM A SURVEY AFTER EVERY CHANGE IN EQUIPMENT, WORKLOAD, OR OPERATING CONDITIONS WHICH MIGHT SIGNIFICANTLY INCREASE THE PROBABILITY OF PERSONS RECEIVING MORE THAN THE MAXIMUM PERMISSIBLE DOSE EQUIVALENT.

Diagnostic X-ray Systems

RADIATION WARNING

X-RAY AND GAMMA-RAYS ARE DANGEROUS TO BOTH OPERATOR AND OTHERS IN THE VICINITY UNLESS ESTABLISHED SAFE EXPOSURE PROCEDURES ARE STRICTLY OBSERVED.

THE USEFUL AND SCATTERED BEAMS CAN PRODUCE SERIOUS OR FATAL BODILY INJURIES TO ANY PERSONS IN THE SURROUNDING AREA IF USED BY AN UNSKILLED OPERATOR. ADEQUATE PRECAUTIONS MUST ALWAYS BE TAKEN TO AVOID EXPOSURE TO THE USEFUL BEAM, AS WELL AS TO SCATTERED RADIATION RESULTING FROM THE PASSAGE OF RADIATION THROUGH MATTER.

THOSE AUTHORIZED TO OPERATE, PARTICIPATE IN, OR SUPERVISE THE OPERATION OF THE EQUIPMENT MUST BE THOROUGHLY FAMILIAR AND COMPLY COMPLETELY WITH THE CURRENT ESTABLISHED SAFE EXPOSURE FACTORS AND PROCEDURES DESCRIBED IN PUBLICATIONS, SUCH AS: SUBCHAPTER J OF TITLE 21 OF THE CODE OF FEDERAL REGULATIONS, "DIAGNOSTIC X-RAY SYSTEMS AND THEIR MAJOR COMPONENTS," AND THE NATIONAL COUNCIL ON RADIATION PROTECTION (NCRP) NO. 102, "MEDICAL X-RAY AND GAMMA-RAY PROTECTION FOR ENERGIES UP TO 10 MEV-EQUIPMENT DESIGN AND USE," AS REVISED OR REPLACED IN THE FUTURE.

THOSE RESPONSIBLE FOR THE PLANNING OF X-RAY AND GAMMA-RAY EQUIPMENT INSTALLATIONS MUST BE THOROUGHLY FAMILIAR AND COMPLY COMPLETELY WITH NCRP NO. 49, "STRUCTURAL SHIELDING DESIGN AND EVALUATION FOR MEDICAL OF X-RAYS AND GAMMA-RAYS OF ENERGIES UP TO 10 MEV," AS REVISED OR REPLACED IN THE FUTURE.

FAILURE TO OBSERVE THESE WARNINGS MAY CAUSE SERIOUS OR FATAL BODILY INJURIES TO THE OPERATOR OR THOSE IN THE AREA.

TO THE USER OF THIS MANUAL

THE USER OF THIS MANUAL IS DIRECTED TO READ AND CAREFULLY REVIEW THE INSTRUCTIONS, WARNINGS AND CAUTIONS CONTAINED HEREIN PRIOR TO BEGINNING INSTALLATION OR SERVICE ACTIVITIES. WHILE YOU MAY HAVE PREVIOUSLY INSTALLED OR SERVICED EQUIPMENT SIMILAR TO THAT DESCRIBED IN THIS MANUAL, CHANGES IN DESIGN, MANUFACTURE OR PROCEDURE MAY HAVE OCCURRED WHICH SIGNIFICANTLY AFFECT THE PRESENT INSTALLATION OR SERVICE.

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EQUIPMENT DESCRIPTION

GENERAL

The Clinix VP4 Table is a horizontal radiographic table for a wide range of X-ray examinations with applications in orthopedics, surgery and urology. The Clinix VP4 is prepared for on-board mounting of the microprocessor-controlled X-ray generator Generix.

The Clinix VP4 consists of a Bucky table with an integrally mounted tube column. The Bucky table is prepared for installation of an electronically controlled, longitudinally movable Bucky unit with Bucky grid and 3-field pickup for operation with Automatic Exposure Control (AEC).

The floating, flat tabletop of the Bucky table is locked in place in the longitudinal and transverse directions by highly effective, foot-operated mechanical brakes. Movement in both directions can be easily released by means of a conveniently placed brake release pedal bar. The easy floating motion of the tabletop and its wide range of displacement ensure convenient patient positioning.

The tube column rides on two rails that are integrally mounted to the Bucky table. The counterbalanced support arm is prepared for mounting the X-ray tube unit (X-ray tube and collimator) and control arm with the control elements. All movements of the tube column and X-ray tube unit are virtually effortless and are arrested by electromagnetic brakes. In addition, the X-ray tube unit rotation about its support arm axis has an automatic detent at 90° for alignment with a vertical Bucky unit etc.

All control elements on the control arm of the tube column, collimator and Bucky table are easily accessible from the front.

CASSETTE TRAY

The Cassette Size Sensing Tray EP is designed for use in conjunction with automatic collimators to provided positive beam limitation of emitted x-rays. The cassette tray senses the size of any cassette (standard or non-standard) for film sizes from 5" x 7" (13 cm x 18 cm) to 14" x 17" (35.5 cm x 43.0 cm) when placed in either orientation in the cassette tray.

The cassette tray has a film cassette locking mechanism which automatically centers the film cassette from front to back. The cassette tray has a cassette side support to support the cassette when the cassette tray is used in a vertical position. The size of the film cassette is measured by two potentiometers, one of which is mechanically connected to a side arm for left to right (width) measurements. The second potentiometer is mechanically connected to the clamping mechanism for front to back (length) measurements. In addition, the cassette tray is equipped with an auxiliary switch which is mechanically operated when the cassette tray is inserted in the Bucky cabinet with a film cassette installed. This switch is an isolated circuit and can be incorporated to perform various functions; such as switching from automatic to manual collimation when a cassette tray has been inserted in the Bucky cabinet without a film cassette.

A 14 pin connector is provided on the rear of the cassette tray which mates with an 14 pin receptacle installed on the Bucky cabinet. The signals "cassette size" and "cassette inserted" are present at the 14 pin receptacle on the Bucky cabinet. For most installations, the collimating system may be wired directly to the 14 pin receptacle on the Bucky cabinet.

TECHNICAL DATA

BUCKY TABLE

Tabletop dimensions:	87.0" x 32.0"
Table height:	27.5"

Tabletop travel from center position

Transverse travel:	± 5.0"
Longitudinal travel:	± 18.5"

The tabletop brakes are released mechanically.

Bucky Unit

Travel:	22.0"
Minimum distance, film center to table head end:	14.8"
Minimum distance, film center to table foot end:	15.7"
Tabletop-film distance:	2.8"

Cassette Tray

Length:	586 mm
Width:	471 mm
Weight:	5.38 kg

Electrical Connection, Bucky

The Bucky unit with Bucky and ACE-pickup is connected to the generator.

TUBE COLUMN

Focal spot vertical travel:	10.0 - 69.9"
Angulation of X-ray tube unit about tube arm axis:	±90°
Angulation of X-ray tube unit about tube arm axis:	+30°/-20°
Detents at:	±90°
Vertical range, support arm:	59.9"
Longitudinal travel, tube column:	50"

Electrical Connection, Tube Column

The power supply for the electromagnetic brakes of the tube column is supplied from the generator.

TOTAL WEIGHT

Approx.:	1100 lbs.

MAIN COMPONENTS

Refer to **Figure 1-1** for the main components.

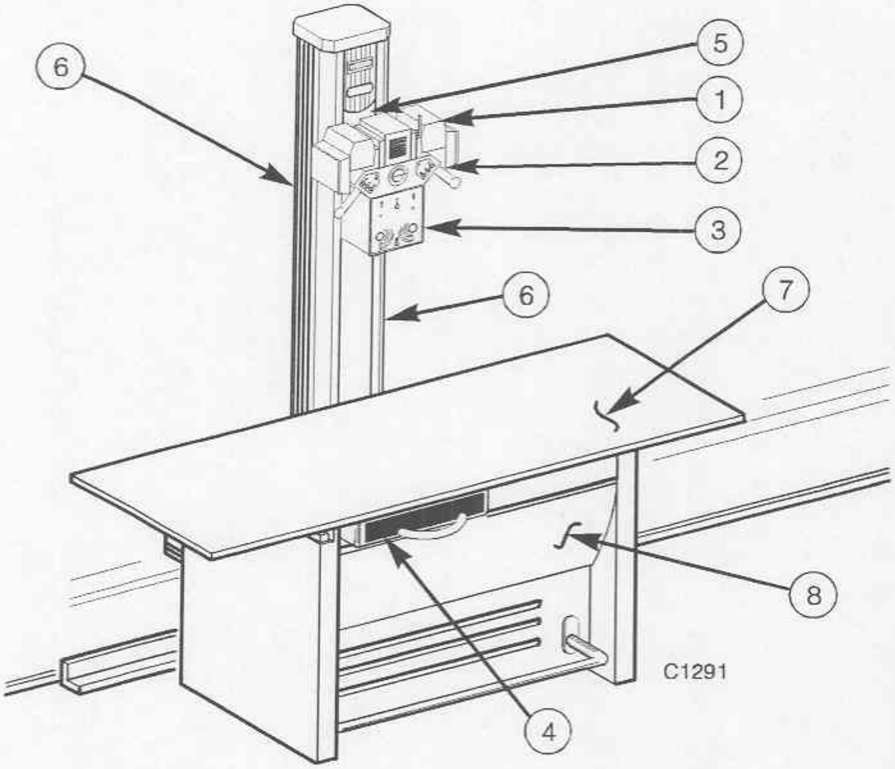


FIGURE 1-1 MAIN COMPONENTS

Refer to **Table 1–1** for the nomenclature of the main components.

TABLE 1-1 MAIN COMPONENTS

No.	Description
1	X-ray Tube Unit
2	Control Arm
3	Collimator
4	Bucky Unit
5	Vertical Carriage with Support Arm
6	Tubestand with Base and Counterweight
7	Floating Tabletop
8	Bucky Table with Integrally Mounted Guide Rails for Tubestand

CONTROLS AND INDICATORS

The following information is intended for the service engineer, and merely conveys the functions of individual controls and indicators.

More detailed operational instructions are provided in the operators manual.

TABLE

Brake Release Pedal Bar

The tabletop (item 1, **Figure 1–2**) may be positioned manually by stepping on the foot-operated brake release pedal bar (item 2, **Figure 1–2**) to release the tabletop brakes and position the floating tabletop manually.

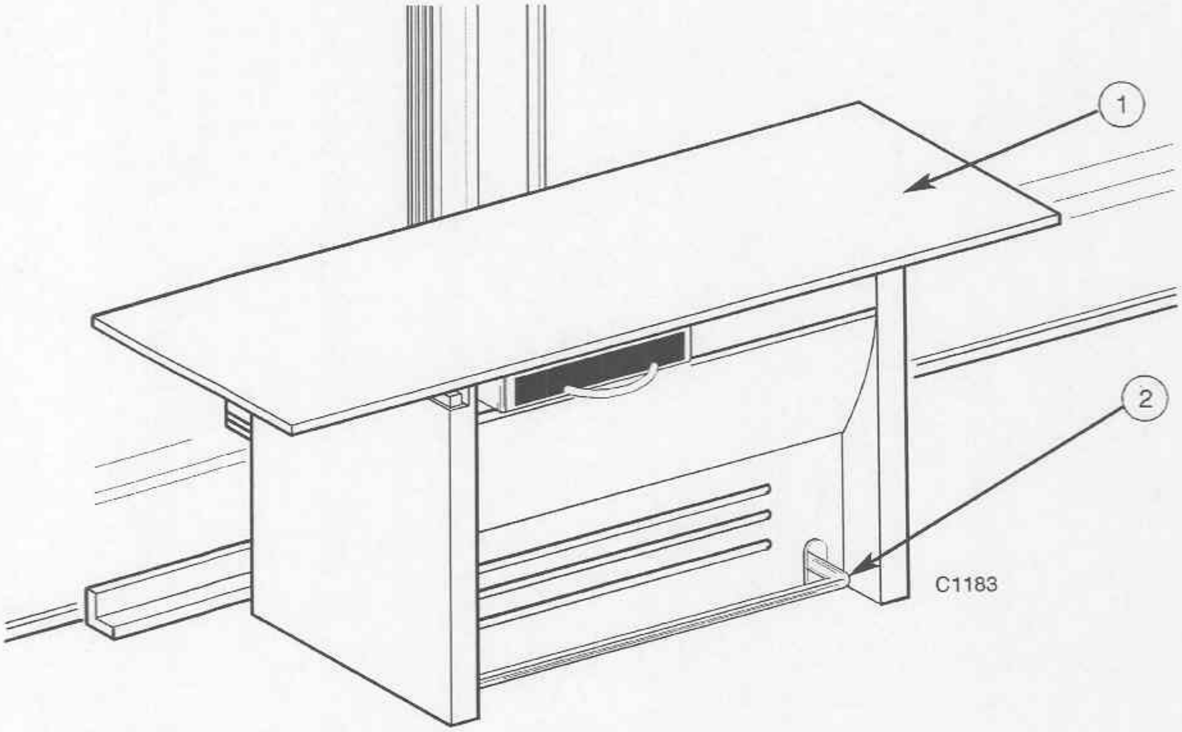


FIGURE 1-2 BUCKY TABLE

The tabletop travel from the center position is as follows:

1. Transverse travel is ± 127 mm
2. Longitudinal travel is ± 470 mm

Bucky Unit

The bucky unit consists of a cassette tray and is shown in **Figure 1–3**. The cassette tray positions the cassette in the bucky unit. Maximum bucky unit travel is 560 mm.

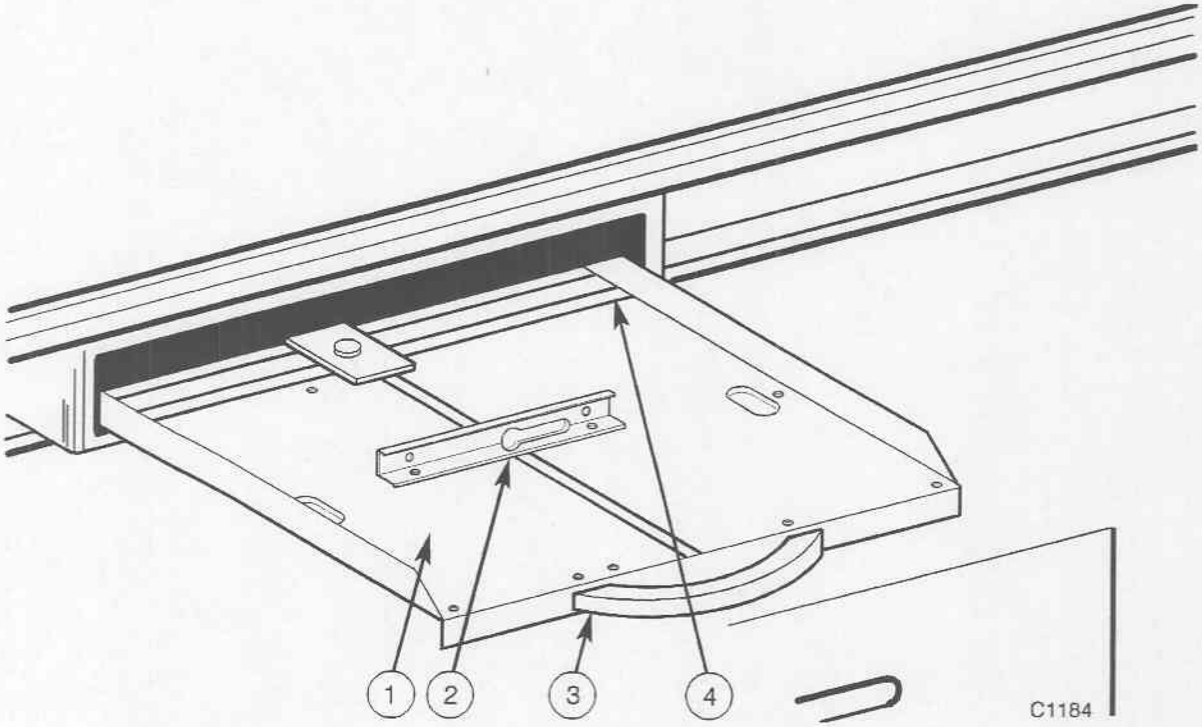


FIGURE 1-3 BUCKY UNIT CONTROLS

An explanation of each bucky unit control is provided in **Table 1–2**.

TABLE 1-2 BUCKY UNIT CONTROLS

No.	Control/Indicator	Function
1	Cassette Tray	Holds the film cassette in place during exposures.
2	Cassette Clamp	Locks the film cassette in position in the cassette tray.
3	Handle	Allows for easy access to the cassette tray.
4	Cassette Positioner	Used to align the cassette to the center of the cassette tray.

Tubestand

The tubestand controls and indicators are shown in **Figure 1–4**.

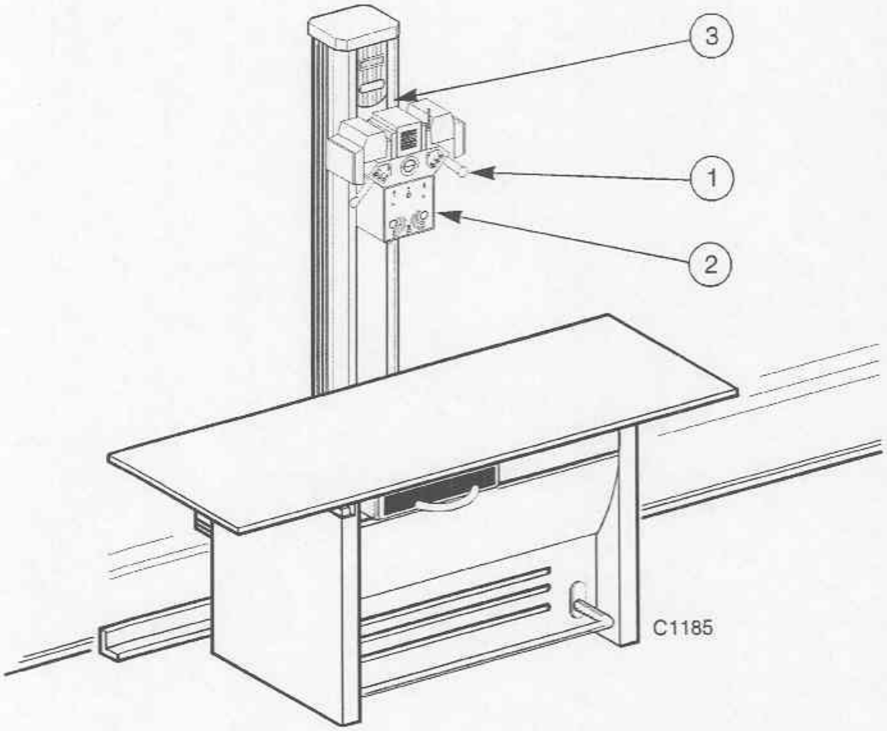


FIGURE 1-4 TUBESTAND

The controls and indicators of the tubestand are described in **Table 1–3**.

TABLE 1-3 TUBESTAND CONTROLS AND INDICATORS

No.	Control/Indicator	Function
1	Control Arm	Refer to control arm paragraph.
2	Collimator	Refer to collimator paragraph.
3	SID Indicator	A scale on the tubestand indicating the SID.

Control Arm

The control arm allows for controlled movement of the x-ray tube including angular motion. The control arm is shown in **Figure 1–5**.

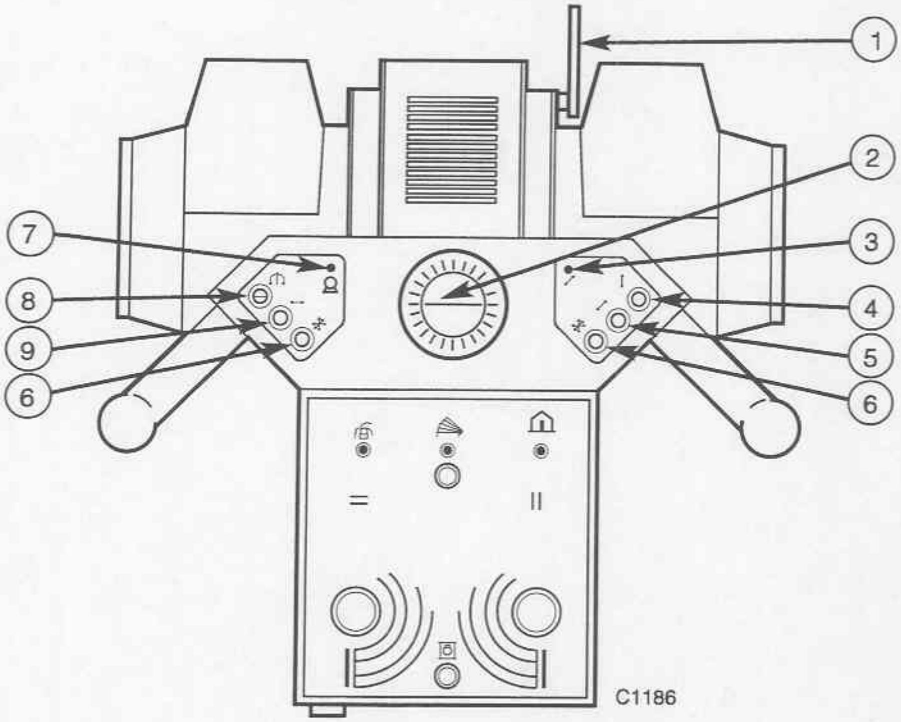


FIGURE 1-5 CONTROL ARM

The controls are operated from the front (operator side) of the tubestand. With the handles grasped, pressure by the operator's thumb on the control arm buttons can easily release the electromagnetic brakes related to one or more of the movements to allow convenient and accurate positioning of the x-ray tube unit. A description of each control and/or indicator is provided in **Table 1–4**.

TABLE 1-4 CONTROL ARM CONTROLS AND INDICATORS

No.	Control/Indicator	Function
1	Lock Handle	Locks x-ray tube in swivel position.
2	Angle Indicator	Indicates angle of x-ray tube unit (rotation about horizontal support arm axis).
3	Center Indicator	Illuminates when x-ray tube is centered transversely to tabletop centerline.
4	Vertical Brake Release	Releases brake for vertical travel of x-ray tube unit.
5	Traverse Brake Release	Releases brake for transverse travel of x-ray tube unit.
6	Central Brake Control	When actuated, all movements are available, except angular motion of the x-ray tube unit.
7	Bucky Select Indicator	Illuminates when bucky table is selected at x-ray generator control.
8	Angular Motion Brake	Releases brake for angular motion of x-ray tube unit (rotation about the horizontal support arm axis).
9	Longitudinal Brake Release	Releases brake for longitudinal travel of the tubestand.

COLLIMATOR

The collimator controls and indicators are shown in **Figure 1–6** and the corresponding functions are tabulated in **Table 1–5**.

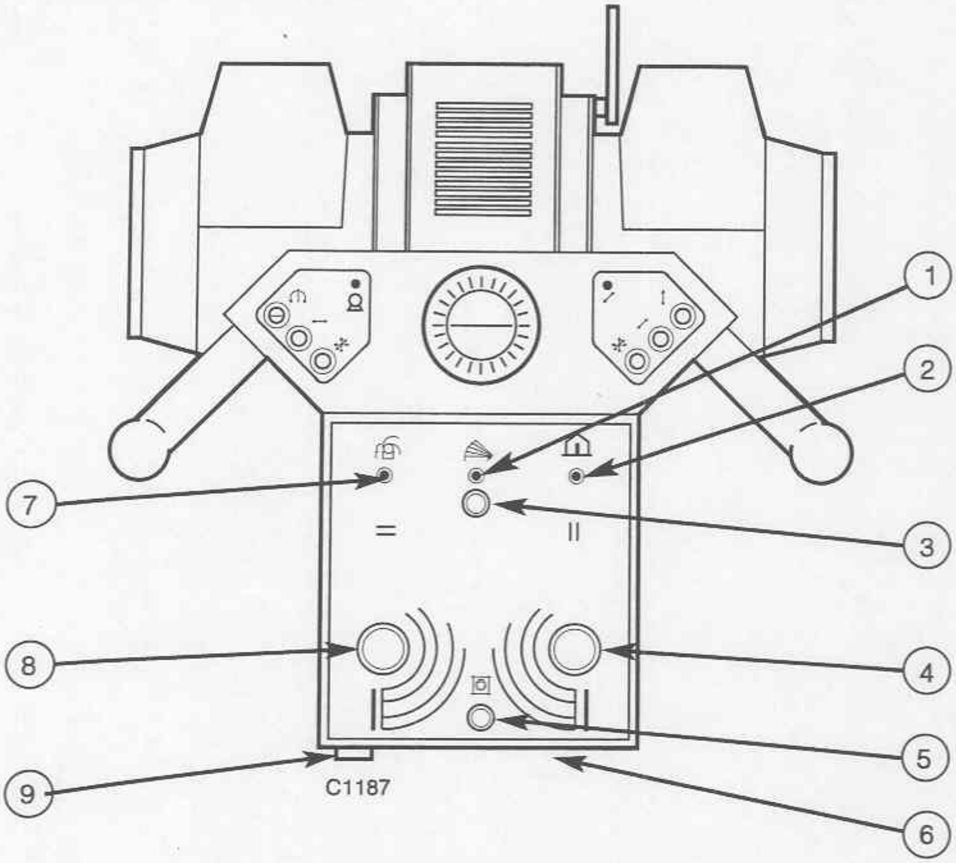


FIGURE 1-6 COLLIMATOR

TABLE 1-5 COLLIMATOR CONTROLS AND INDICATORS

No.	Control/Indicator	Function
1	Collimation Manual Mode Indicator	Illuminates when manual collimation mode is selected.
2	SID Range Indicator	Illuminates when exposure is inhibited due to a collimation error.
3	Manual Collimation Selector	Selects/Deselects manual collimation mode.
4	Collimator Adjustment Control	Allows for manual opening and closing of collimator vanes (longitudinally to tabletop).
5	Collimator Light Switch	Turns on collimator light.
6	Center Indicator	Illuminates (for approximately 30 seconds) when collimator light switch is pressed.
7	Automatic Collimation Indicator	Illuminates when conditions for automatic collimation are met (cassette in bucky tray, x-ray tube unit in 36" to maximum SID range, vertical central ray).
8	Collimator Adjustment Control	Allows for manual opening and closing of collimator vanes (transversely to tabletop).
9	Measuring Tape	Convenient method of checking SID.

EQUIPMENT LABEL

The equipment label is located low on the front of the column.

REPLACEMENT OF PARTS AND ASSEMBLIES

ROLLERS AND BALL BEARINGS FOR LONGITUDINAL MOVEMENT

The floating tabletop moves longitudinally on four rollers (3, **Figure 2-1**) in the support rails of the tabletop, and is guided on its side by four ball bearings (2). All rollers and ball bearings are attached to the intermediate frame (1).

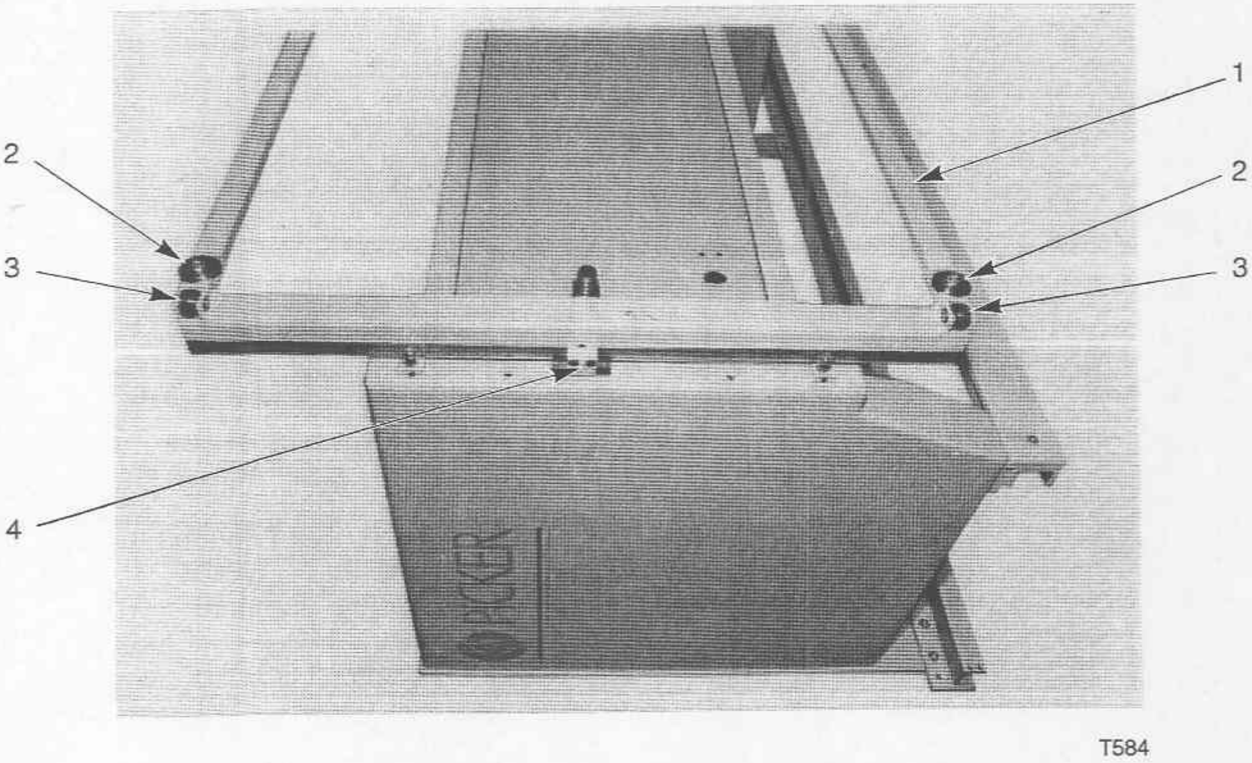


FIGURE 2-1 BUCKY TABLE WITH TABLETOP REMOVED

To replace the longitudinal rollers or ball bearings, the tabletop must be removed. To remove the tabletop and replace longitudinal roller(s) or ball bearing(s), perform the following:

1. Remove two end stops (2, **Figure 2-2**) at the foot end of the tabletop.

WARNING

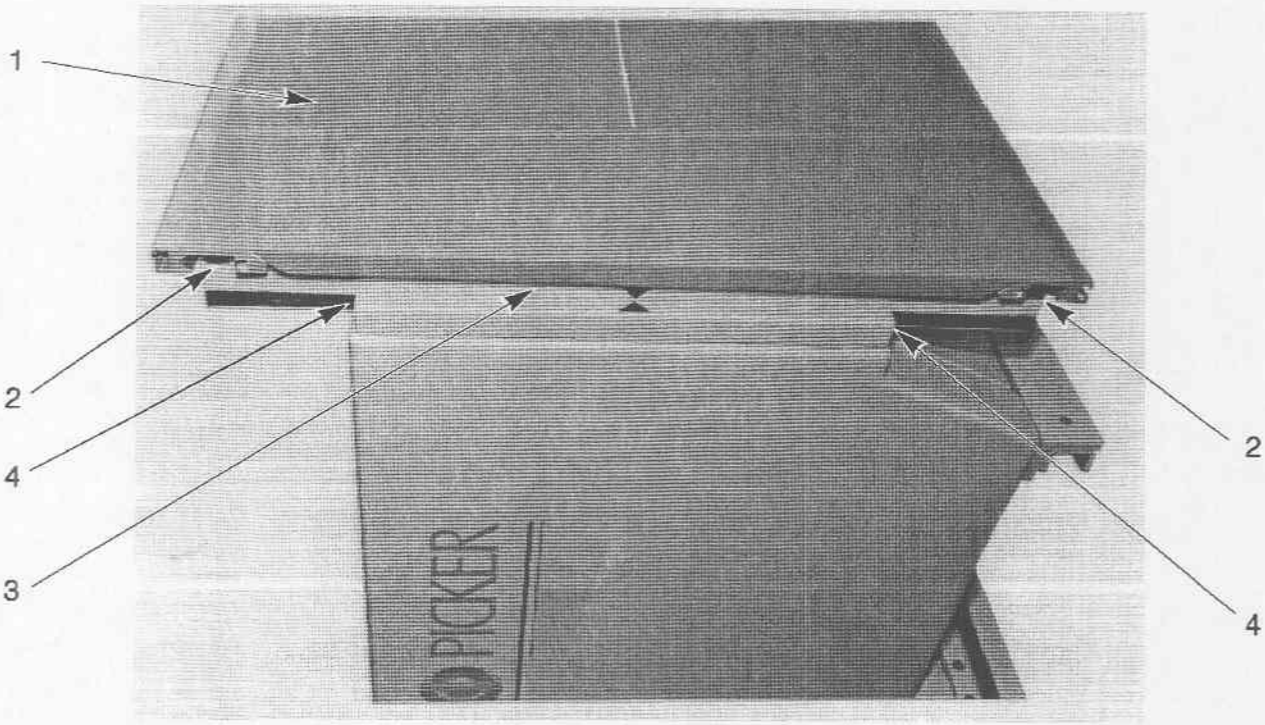
THE TABLETOP IS HEAVY AND SHOULD BE LIFTED BY AT LEAST TWO PERSONS. FAILURE TO COMPLY MAY RESULT IN PERSONNEL INJURY OR EQUIPMENT DAMAGE.

2. Slide the tabletop toward the foot end and remove from the table.

3. As necessary, replace roller(s) or ball bearing(s).

4. Slide the tabletop onto the table in the same orientation in which it was removed.

5. Re-install the two end stops (2).



T585

FIGURE 2-2 BUCKY TABLE WITH TABLETOP IN PLACE

ROLLERS AND BALL BEARINGS FOR TRANSVERSE MOVEMENT

The floating tabletop moves transversely on four rollers (1, **Figure 2-3**) in the support rails of the intermediate frame (1, **Figure 2-1**), and is guided on its sides by four ball bearings (2, **Figure 2-3**). All rollers and ball bearings are attached to the lower frame of the Bucky table.

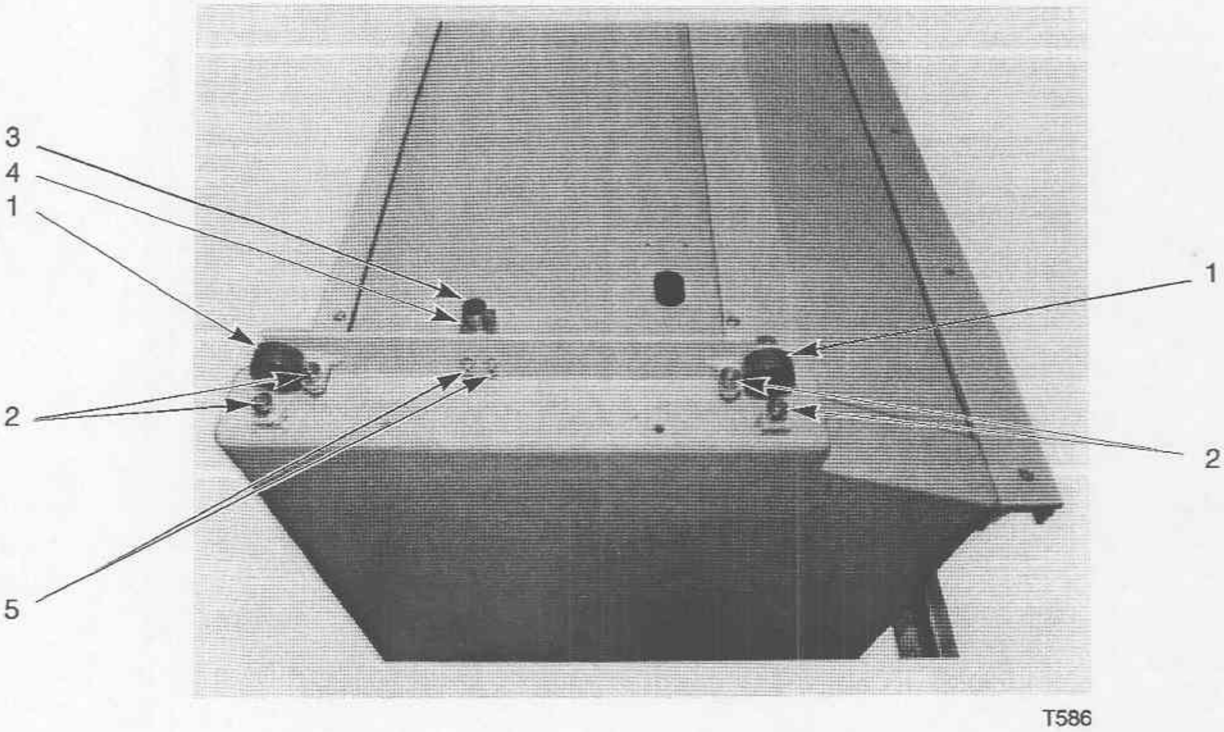


FIGURE 2-3 LOWER FRAME WITH BALL BEARINGS

To replace the transverse rollers or ball bearings, the tabletop must be removed. To remove the tabletop and replace transverse roller(s) or ball bearing(s), perform the following:

1. Remove two end stops (2, **Figure 2-2**) at the foot end of the tabletop.

WARNING

THE TABLETOP AND INTERMEDIATE FRAME ASSEMBLY IS HEAVY AND SHOULD BE LIFTED BY AT LEAST TWO PERSONS. FAILURE TO COMPLY MAY RESULT IN PERSONNEL INJURY OR EQUIPMENT DAMAGE.

2. Loosen one screw each on the inside of the right and left sidewalls (2, **Figure 2-4**) and one screw each (1) on the right and left side of the upper surface of the connecting bar.

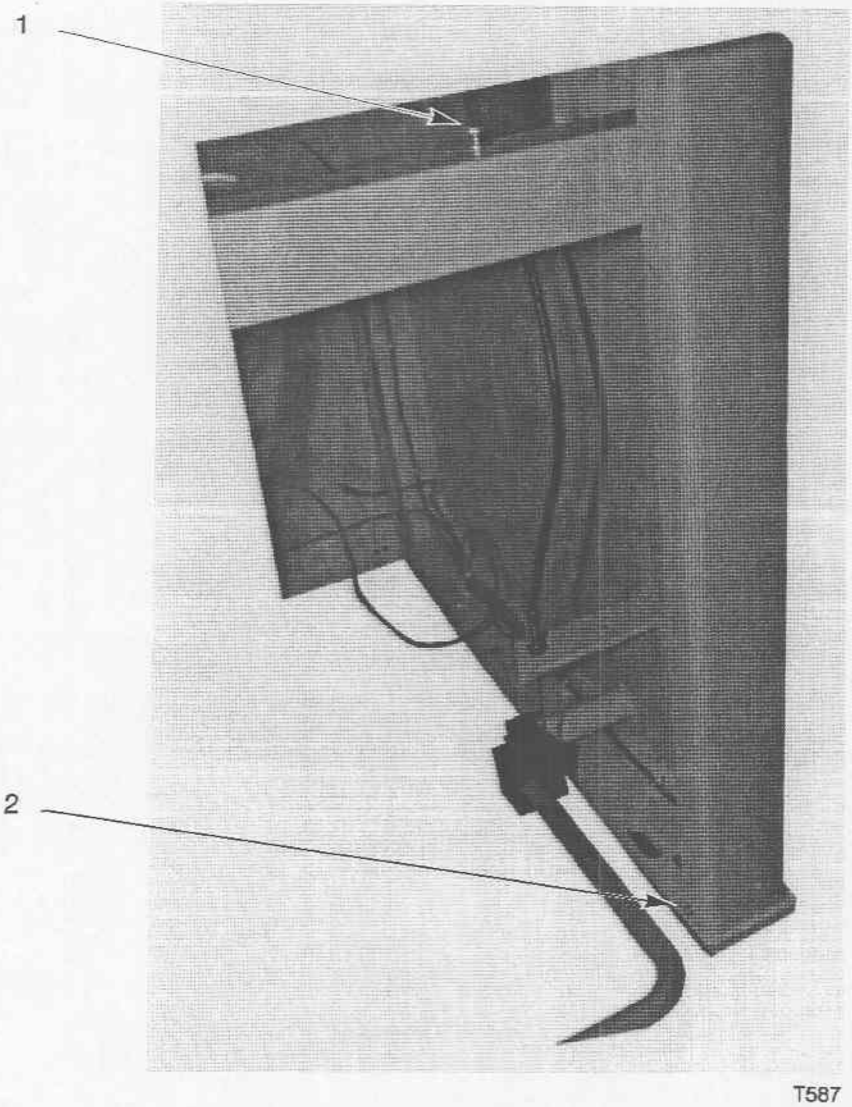


FIGURE 2-4 BRAKE RELEASE PEDAL BAR

3. Remove the front cover of the table.

4. From the inside of the head end and foot end cover plates (3, **Figure 2-2**), remove two nuts (4) (each end).

5. Remove the head end and foot end cover plates.

6. Remove the bumper from the head end and foot end of the intermediate frame (1, **Figure 2-1**).

7. Release the brake and remove the tabletop and intermediate frame assembly by sliding it away from the tube column.

8. As necessary, replace roller(s) or ball bearing(s).

9. Reinstall the tabletop and intermediate frame assembly onto the table by performing the disassembly steps in reverse order.

PRESSURE SPRINGS AND BRAKES FOR TABLETOP MOVEMENT

The right brake (3, **Figure 2-3**) is located in the right sidewall and the left brake in the left sidewall. The brakes are actuated by the brake release pedal bar (6, **Figure 2-5**).

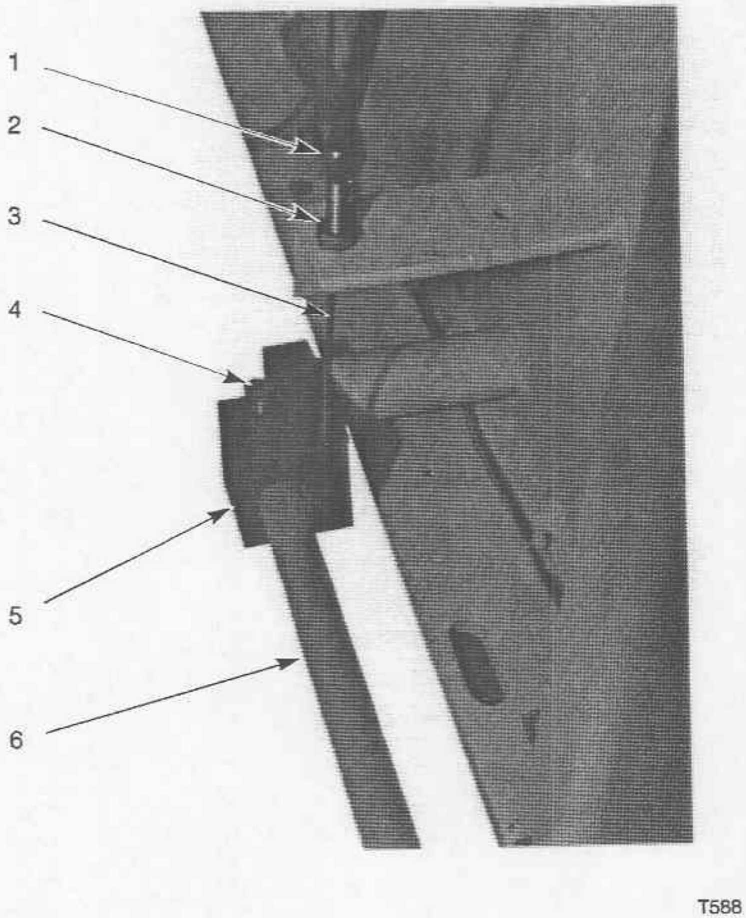


FIGURE 2-5 REMOVING BRAKE RELEASE PEDAL BAR

To replace the pressure springs (4, **Figure 2-3**) or the brake bolts (3), proceed as follows:

NOTE

This procedure describes the steps necessary for the right brake. For left brake, substitute left and right directions accordingly.

1. Remove two end stops (2, **Figure 2-2**) located at the foot end of the tabletop.

WARNING

THE TABLETOP IS HEAVY AND SHOULD BE LIFTED BY AT LEAST TWO PERSONS. FAILURE TO COMPLY MAY RESULT IN PERSONNEL INJURY OR EQUIPMENT DAMAGE.

2. Slide the tabletop toward the foot end and remove from the table.
3. Loosen one screw each on the inside of the right and left sidewalls (2, **Figure 2-4**), and one screw each (1) on the right and left side of the upper surface of the connecting bar.
4. Remove the front cover of the table.
5. Pull up on the brake release pedal bar (6, **Figure 2-5**) and disconnect the Bowden cable (3) from the brake block (5).
6. Remove the brake (3, **Figure 2-3**) and pressure spring (4) by pulling them upward.
7. The brake (3, **Figure 2-3**) may be adjusted using the screw (1, **Figure 2-5**) and locknut (2).

NOTE

Adjust the brake bolts to optimize the braking action for both the longitudinal and transverse movements of the tabletop. When the brake release pedal is pressed, the distance between the brake bolt and the tabletop panel must be at least 0.16in. (4mm).

If this adjustment is not achievable, readjust the brake block using two screws (5, **Figure 2-3**).

8. For the left brake and/or pressure spring, perform this procedure substituting the left side for the right side.

BRAKE RELEASE PEDAL BAR

The brake release pedal bar (6, **Figure 2-5**) is foot-actuated and releases the brakes of the floating tabletop. To replace the brake release pedal bar, proceed as follows:

1. Loosen one screw each on the inside of the right and left sidewalls (2, **Figure 2-4**), and one screw each (1) on the right and left side of the upper surface of the connecting bar.
2. Remove the front cover of the table.
3. Loosen screw (4, **Figure 2-5**) securing the pedal bar in the right brake block (5).
4. Loosen screw (4, **Figure 2-5**) securing the pedal bar in the left brake block.
5. Pull the brake release pedal bar (6) out of the brake blocks (5) by pulling away from the table.
6. Install replacement brake release pedal bar and reassemble in the reverse order of steps.

WIRE ROPES

The support arm with the x-ray tube unit is counterbalanced by a counterweight using wire ropes. The counterweight travels within the vertical column (4, **Figure 2-6**). The counterweight is guided by two wire ropes, which pass through the interior of the vertical column and are fastened across the pulley to the vertical carriage.

One wire rope controls the vertical movement and supports the entire weight. The other wire rope is strictly a safety feature. It is present only in the event that the first cable fails.

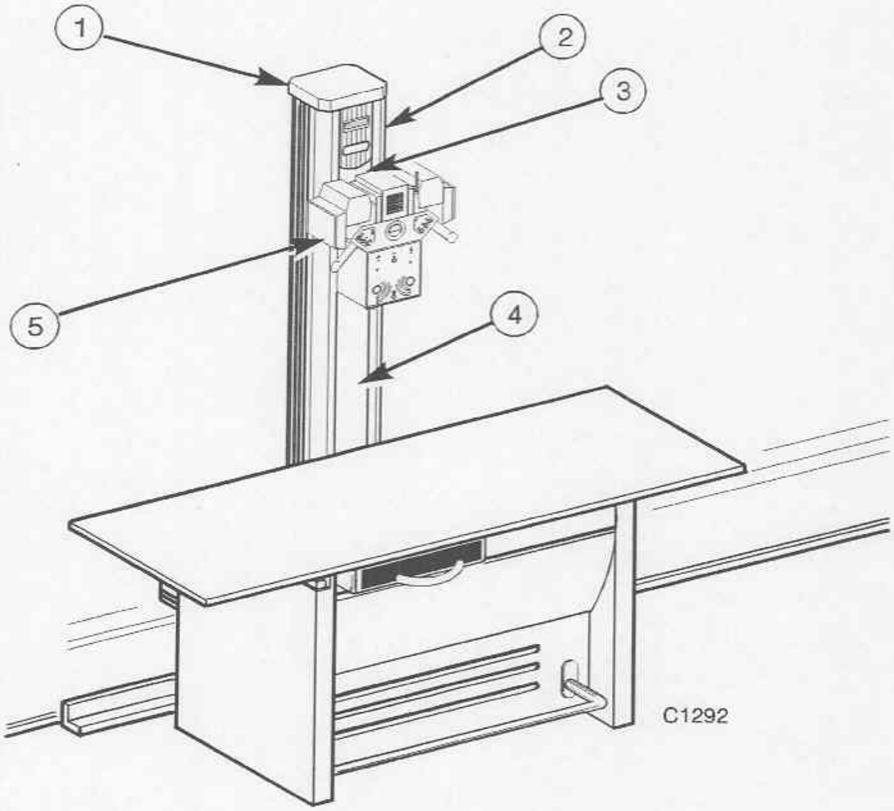


FIGURE 2–6 CLINIX VP4

To ensure continued operational safety, it is vital that the wire ropes, which are known to undergo a certain degree of wear and tear, are examined periodically. Examine the wire ropes for any signs of excessive or abnormal wear or obvious damage. If necessary, replace the wire ropes as follows:

1. Move the column to the head end of the table.
2. Move the tabletop all the way toward the foot end (right).
3. Place a foam pad at the head end of the tabletop as shown in **Figure 2–7**.

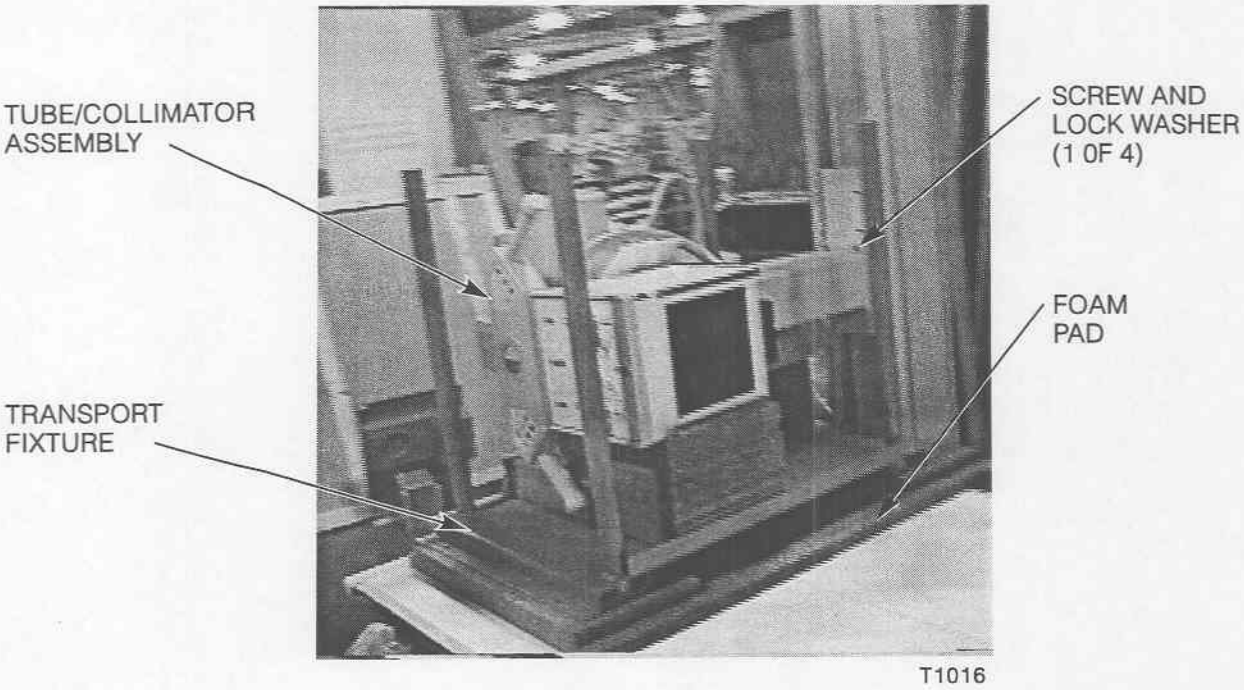

TUBE/COLLIMATOR ASSEMBLY
SCREW AND LOCK WASHER (1 0F 4)
FOAM PAD
TRANSPORT FIXTURE
T1016

FIGURE 2–7 TUBE AND COLLIMATOR ASSEMBLY

4. Place the tube/collimator transport fixture on the foam pad as shown in **Figure 2–7**.

5. Rotate the tube/collimator assembly so that the collimator is aimed toward the foot end as shown in **Figure 2–7**.

6. Lower the tube/collimator assembly into the transport fixture as shown in **Figure 2–7**.

7. Remove the counterweight support pin and bracket from the back of the vertical column (refer to **Figure 2–8**).

8. Insert the long end of the counterweight through the hole in the back of the vertical column and into the counterweight carriage inside the column.

NOTE

It may be necessary to move the tubearm up or down slightly to get the hole in the counterweight carriage to align with the hole in the column.

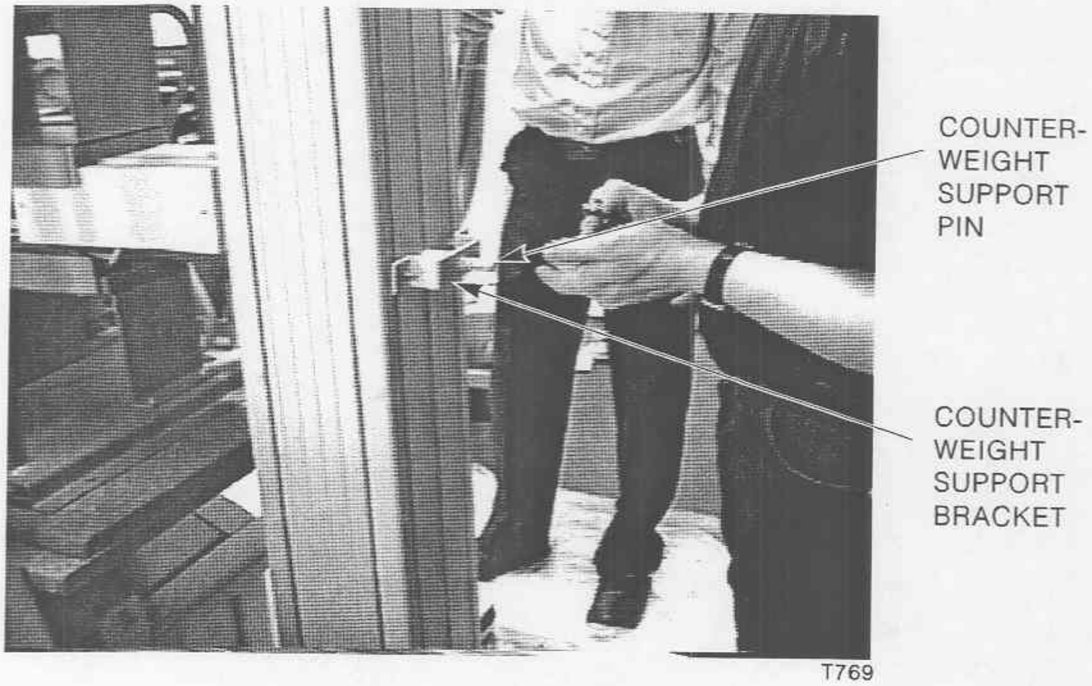

COUNTER-
WEIGHT
SUPPORT
PIN
COUNTER-
WEIGHT
SUPPORT
BRACKET
T769

FIGURE 2–8 COUNTERWEIGHT RESTRAINT PIN

9. Remove four screws and lock washers (refer to **Figure 2–9**) securing the tubearm to the vertical carriage and push the tubearm in to its fully retracted position.

10. If necessary, move the tabletop slightly forward away from the column.

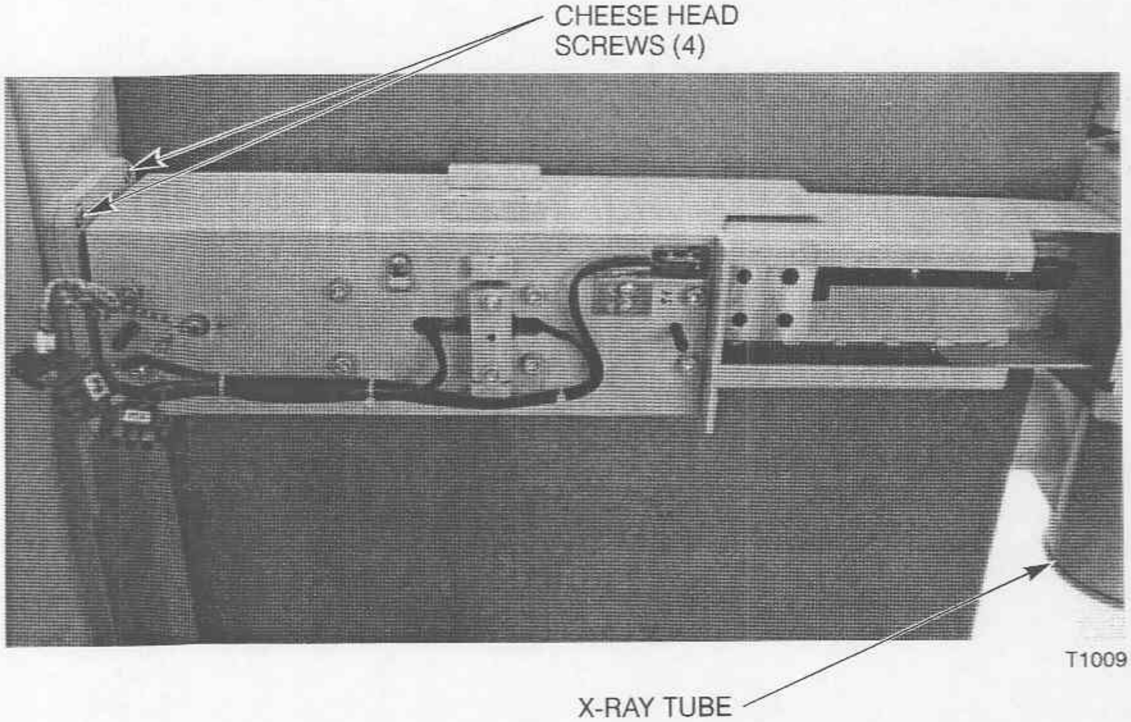


FIGURE 2–9 SUPPORT ARM WITH X-RAY TUBE UNIT

11. To enable access to the top of the vertical carriage, lower the stand to a horizontal (or slightly inclined) position. Refer to **Figure 2–10**.

12. Unfasten the rope for the linear transducer from the vertical carriage.

13. Remove the retainer retaining the wire ropes in the pulleys.

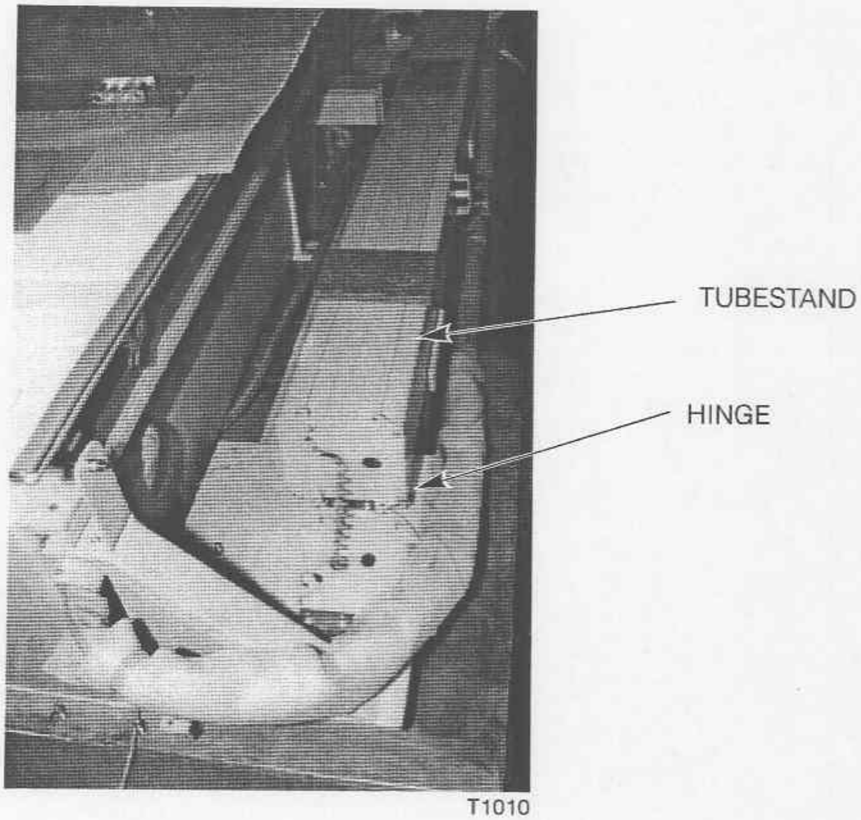


FIGURE 2–10 GUIDE RAILS AND TUBE COLUMN

14. Remove retaining screws securing the cover (1, **Figure 2-11**), and tilt it back for access.

15. Push the vertical carriage upward until the wire ropes (3 and 4) can be taken off of the pulley (2).

16. Retract the counterweight from the interior of the column until the rope anchor in the counterweight can be pushed out with a copper pin.

17. Replace the wire ropes (3 and 4, **Figure 2-11**) and re-anchor them to the counterweight ensuring that no strand extends beyond the felt strip.

18. Reinsert counterweight into interior of column.

19. Retract the vertical carriage (3, **Figure 2-6**) upward off the guide rails.

20. Push both wire ropes (1 and 2, **Figure 2-12**) downward at the vertical carriage, and remove each hex nut (3).

21. Retract the wire ropes upward to detach them from the vertical carriage.

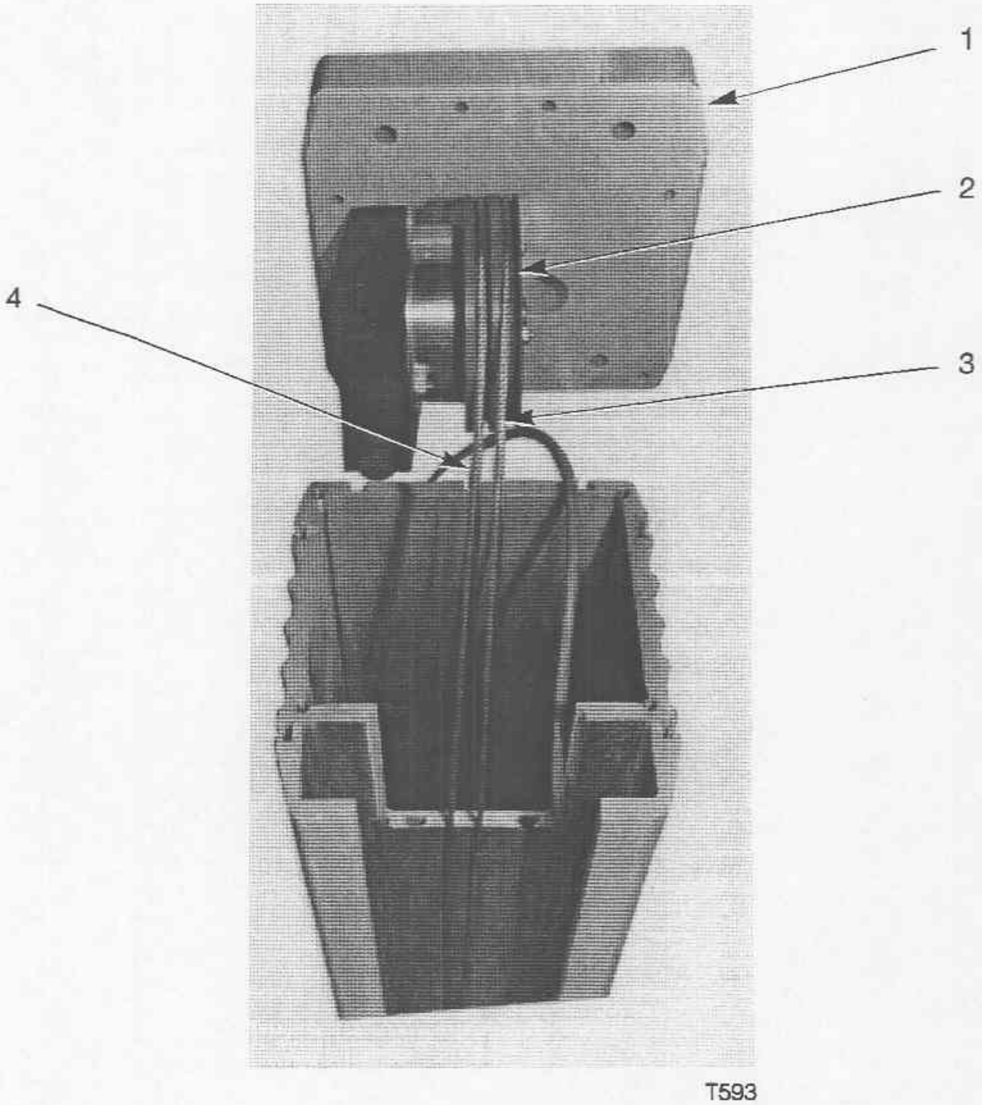


FIGURE 2-11 PULLEY WITH BRAKE

22. Insert the new wire ropes (1 and 2, **Figure 2-12**) with their threaded ends into the vertical carriage from above, until the pressure spring and hex nut (3) can be installed.

23. Reattach the retainer that holds the wire ropes (3 and 4) around the pulley (2).

24. Reattach cover (1, **Figure 2-11**) using the retaining screws. Ensure that the wire ropes (3 and 4), are properly routed around the pulley (2).

25. Return column to the upright position.

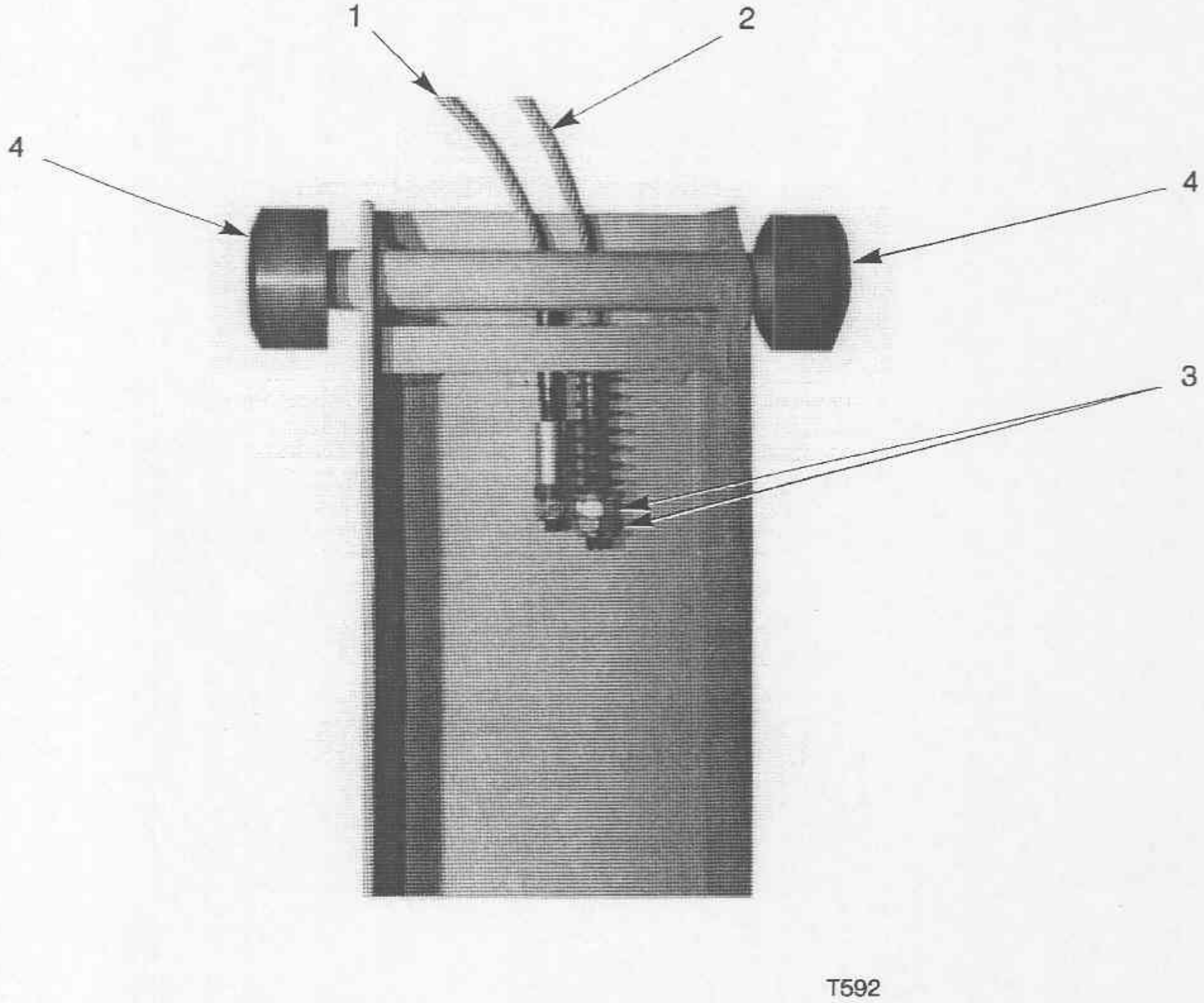


FIGURE 2-12 VERTICAL CARRIAGE

26. Reverse order of steps to reassemble vertical carriage and support arm.

PULLEY WITH BRAKE

The pulley with brake (2, **Figure 2-11**) reverses the direction of the wire ropes (3 and 4) for the counterweight that counterbalances the vertical carriage with support arm and x-ray tube unit. The electromagnetic brake releases or fixes the vertical movement to allow precise vertical positioning of the x-ray tube unit.

To replace the pulley with brake (2, **Figure 2-11**), perform the following:

1. Move the column to the head end of the table.

2. Move the tabletop all the way toward the foot end (right).
3. Place a foam pad on the head end of the tabletop as shown in **Figure 2–7**.
4. Place the tube/collimator transport fixture on the foam pad as shown in **Figure 2–7**.
5. Rotate the tube/collimator assembly so that the collimator is aimed toward the foot end as shown in **Figure 2–7**.
6. Lower the tube/collimator assembly into the transport fixture as shown in **Figure 2–7**.
7. Remove the counterweight support pin and bracket from the back of the vertical column (refer to **Figure 2–8**).
8. Insert the long end of the counterweight through the hole in the back of the vertical column and into the counterweight carriage inside the column.

NOTE

It may be necessary to move the tubearm up or down slightly to get the hole in the counterweight carriage to align with the hole in the column.

9. Remove four screws and lock washers (refer to **Figure 2–9**) securing the tubearm to the vertical carriage and push the tubearm in to its fully retracted position.
10. If necessary, move the tabletop slightly forward away from the column.
11. To enable access to the top of the vertical carriage, lower the stand to a horizontal (or slightly inclined) position.
12. Unfasten the rope for the linear transducer from the vertical carriage.
13. Remove the retainer retaining the wire ropes in the pulleys.
14. Remove retaining screws securing the cover (1, **Figure 2-11**), and tilt it back for access.
15. Push the vertical carriage upward until the wire ropes (3 and 4) can be taken off of the pulley (2).

16. Disconnect the electrical leads.
17. Remove the retaining ring.
18. Remove the pulley (2, **Figure 2-11**) from the shaft. Note position of compensating disks.
19. Remove the brake disk from the pulley.
20. Remove the brake body from the support block.

NOTE

Do not drop the pulley and/or brake.

21. Install replacement pulley and secure it to the brake disk with the three oval head screws.
22. Reverse order of steps for reassembly.
23. Perform the functional test in accordance with the installation manual.

ANGULATION BRAKE FOR THE X-RAY TUBE UNIT

The angulation brake for the x-ray tube unit is attached to the x-ray tube cross arm. This is an electromagnetic brake of the "dead-man" type, which controls the angular movement of the x-ray tube unit. The angular motion is controlled using the control arm controls.

To replace the angulation brake for the x-ray tube unit, perform the following:

1. Move the column to the head end of the table.
2. Move the tabletop all the way toward the foot end (right).
3. Place a foam pad on the head end of the tabletop as shown in **Figure 2–7**.

4. Place the tube/collimator transport fixture on the foam pad as shown in **Figure 2–7**.
5. Rotate the tube/collimator assembly so that the collimator is aimed toward the foot end as shown in **Figure 2–7**.
6. Lower the tube/collimator assembly into the transport fixture as shown in **Figure 2–7**.
7. Remove the counterweight support pin and bracket from the back of the vertical column (refer to **Figure 2–8**).
8. Insert the long end of the counterweight through the hole in the back of the vertical column and into the counterweight carriage inside the column.

NOTE

It may be necessary to move the tubearm up or down slightly to get the hole in the counterweight carriage to align with the hole in the column.

9. Remove four screws and lock washers (refer to **Figure 2–9**) securing the tubearm to the vertical carriage and push the tubearm in to its fully retracted position.
10. If necessary, move the tabletop slightly forward away from the column.
11. Remove the cover on the underside of the cross arm and disconnect connector P3.
12. Remove two screws securing the click stop (**Figure 2–13**) to the cross arm and remove the click stop.
13. Remove four screws securing the brake shaft in the housing and remove the brake shaft.

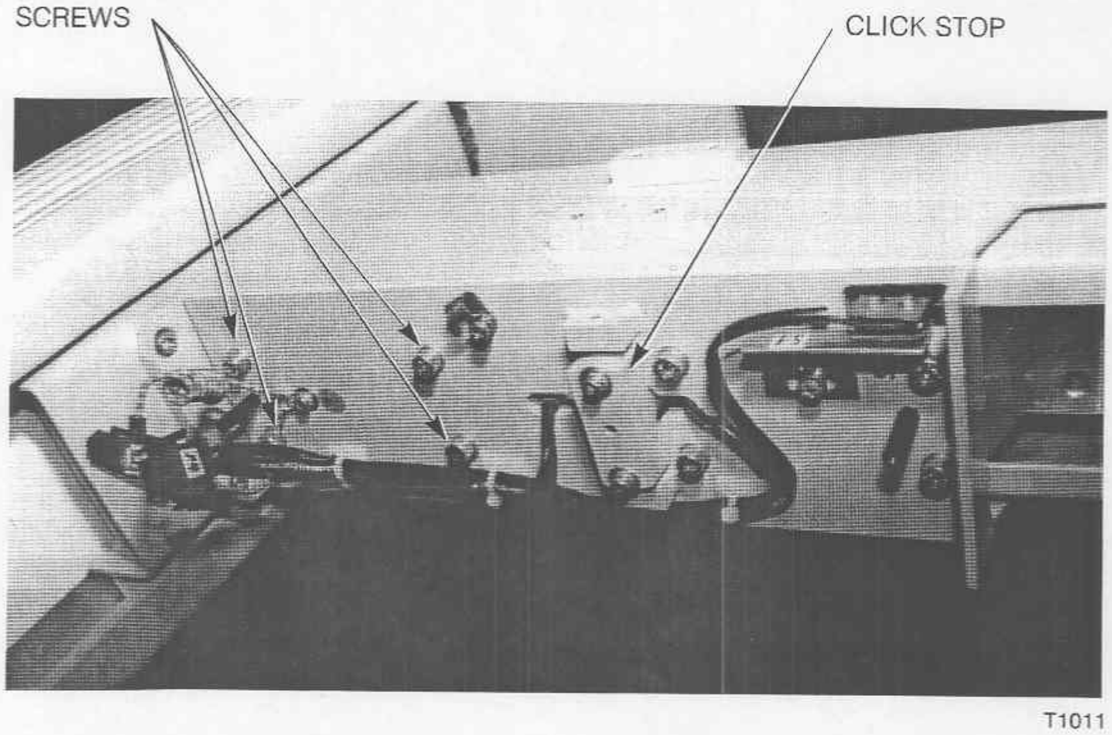


FIGURE 2–13 TUBE SUPPORT CROSS ARM

14. Remove screws (**Figure 2–14**) securing the armature disk and pull out the armature/notched disk.

15. Remove the magnet (**Figure 2–14**) from the bearing block.

16. Reverse steps for reassembly.

NOTE

Take care when installing spacer sleeve. The larger diameter should be positioned towards the ball bearing.

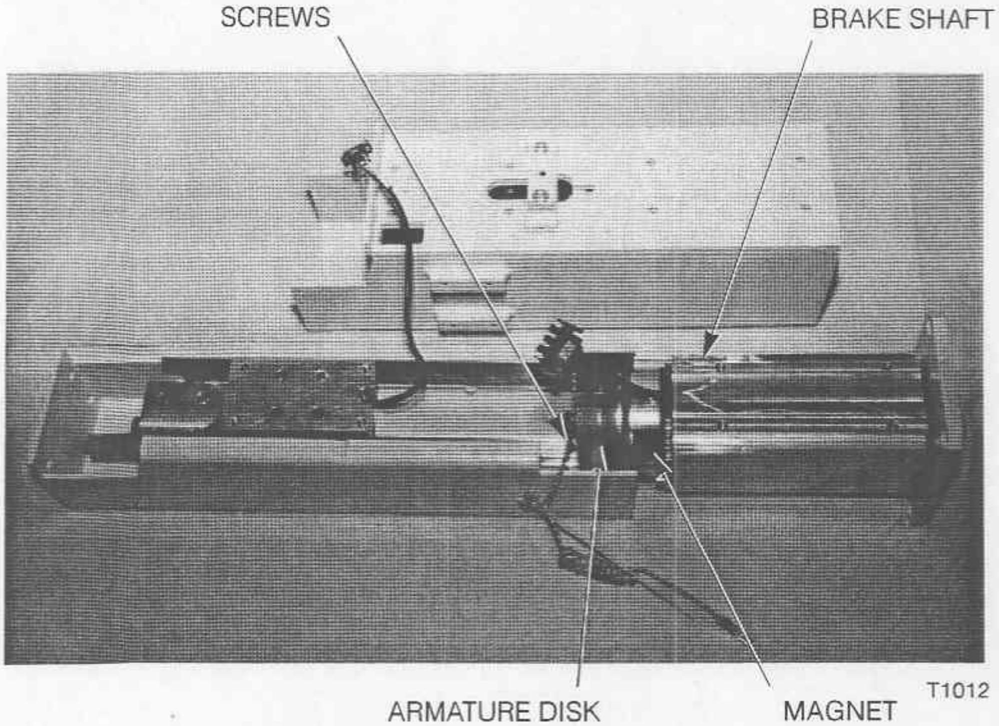


FIGURE 2–14 ANGULATION BRAKE SHAFT ASSEMBLY

ROLLERS ON THE VERTICAL CARRIAGE

The vertical carriage with support arm (3, **Figure 2-6**) runs on four rollers (4, **Figure 2-12**) within the rails of the column. This movement serves to adjust the vertical SID to the Bucky unit.

To replace the rollers on the vertical carriage, perform the following:

1. Move the column to the head end of the table.
2. Move the tabletop all the way toward the foot end (right).
3. Place a foam pad on the head end of the tabletop as shown in **Figure 2–7**.
4. Place the tube/collimator transport fixture on the foam pad as shown in **Figure 2–7**.
5. Rotate the tube/collimator assembly so that the collimator is aimed toward the foot end as shown in **Figure 2–7**.
6. Lower the tube/collimator assembly into the transport fixture as shown in **Figure 2–7**.

7. Remove the counterweight support pin and bracket from the back of the vertical column (refer to **Figure 2–8**).

8. Insert the long end of the counterweight through the hole in the back of the vertical column and into the counterweight carriage inside the column.

NOTE

It may be necessary to move the tubearm up or down slightly to get the hole in the counterweight carriage to align with the hole in the column.

9. Remove four screws and lock washers (refer to **Figure 2–9**) securing the tubearm to the vertical carriage and push the tubearm in to its fully retracted position.

10. If necessary, move the tabletop slightly forward away from the column.

11. To enable access to the top of the vertical carriage, lower the stand to a horizontal (or slightly inclined) position.

12. Unfasten the rope for the linear transducer from the vertical carriage.

13. Remove the retainer retaining the wire ropes in the pulleys.

14. Remove retaining screws securing cover (1, **Figure 2-11**), and tilt it back for access.

15. Push the vertical carriage upward until the wire ropes (3 and 4) can be taken off of the pulley (2).

16. Pull the vertical carriage (3, **Figure 2-6**) up out of the guide rails of the column.

17. Remove and replace the rollers (4, **Figure 2-12**).

18. Reverse steps for reassembly.

19. Perform the functional test in accordance with the installation manual.

ROLLERS AND BALL BEARINGS AT THE COLUMN BASE

The tubestand runs on rollers within two guide rails. A single roller (**Figure 2-15**) runs in the upper guide rail on eccentric bolts allowing vertical adjustment of the column. Two rollers (**Figure 2-16**) run in the lower guide rail (**Figure 2-15**).

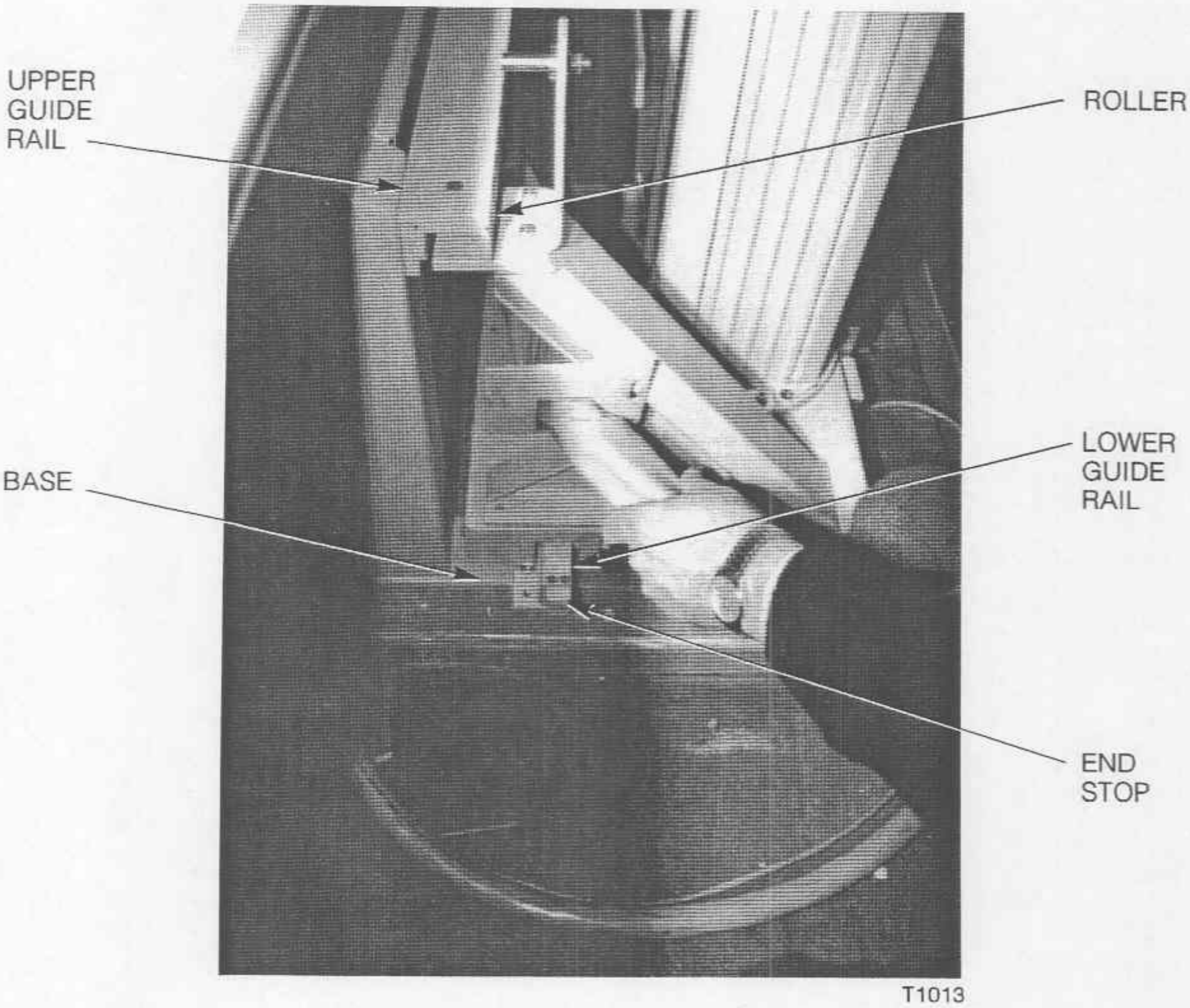

UPPER GUIDE RAIL
ROLLER
BASE
LOWER GUIDE RAIL
END STOP
T1013

FIGURE 2–15 COLUMN BASE

The tubestand is guided laterally by four ball bearings (**Figure 2-16**) on the lower guide rail (**Figure 2-15**).

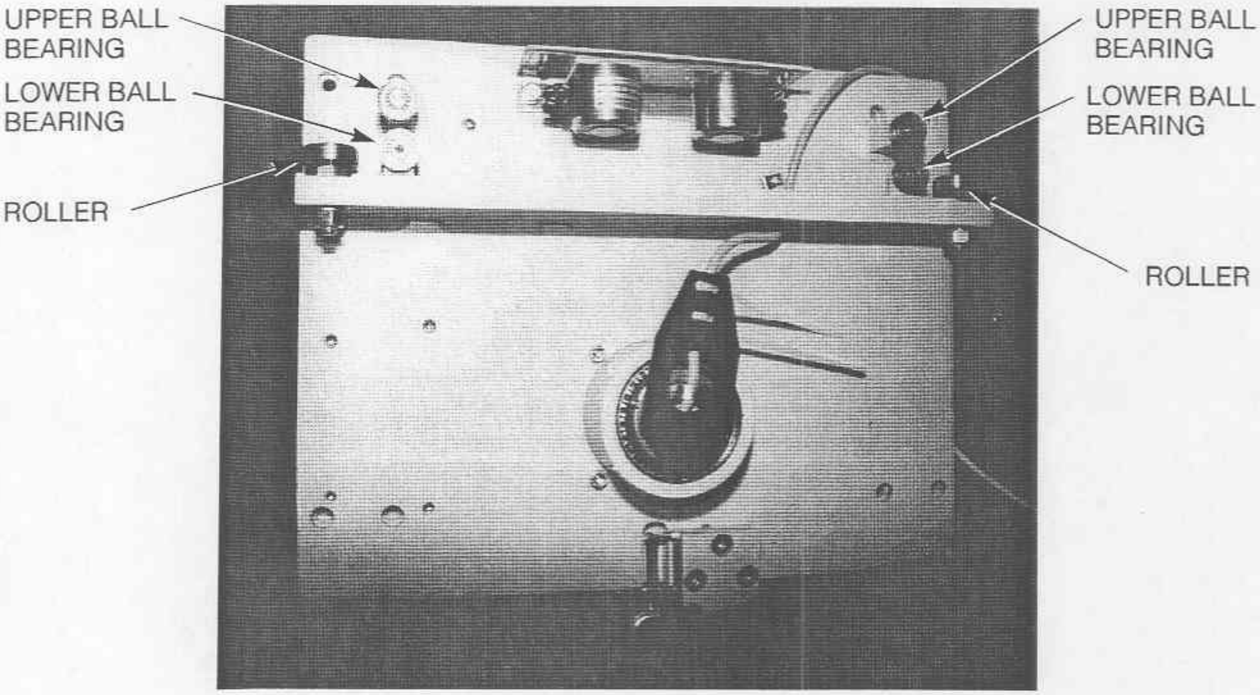

UPPER BALL BEARING
LOWER BALL BEARING
ROLLER
UPPER BALL BEARING
LOWER BALL BEARING
ROLLER
T1014

FIGURE 2–16 UNDERSIDE OF COLUMN BASE

To replace the rollers (**Figure 2-16** and **Figure 2-15**) and/or ball bearings (**Figure 2-16**), perform the following:

CAUTION

TO PREVENT DAMAGE TO INDIVIDUAL PARTS, BE SURE TO READJUST THE TWO ECCENTRIC BALL BEARINGS (**FIGURE 2-16**) THAT GUIDE THE MOVEMENT LATERALLY.

1. Remove the end stop (**Figure 2-15**) from the lower guide rail.
2. Carefully push the column with its base off the guide rails just far enough to provide clear access to the respective rollers or ball bearings.

NOTE

Insert a wedge or similar implement (a board or plate up to 14 mm in thickness) between the column base and the floor, to take the load off the ball bearings and rollers.

3. Replace the rollers or ball bearings.

4. Carefully reinsert the column with its base (**Figure 2-15**) into both guide rails. A board or plate up to 14 mm in thickness may be used to facilitate this step.

CAUTION

TO AVOID DAMAGE, TAKE CARE TO INSERT THE LATERAL GUIDE ROLLERS (**FIGURE 2-16**) AND THE LONGITUDINAL BRAKE OF THE TUBESTAND CORRECTLY INTO THE LOWER GUIDE RAIL (**FIGURE 2-15**). OTHERWISE, DAMAGE TO THE EQUIPMENT MAY RESULT.

5. Readjust the eccentric ball bearings (**Figure 2-16**).

6. Ensure that the tubestand runs easily within the guide rails (**Figure 2-15**).

7. Reinstall the end stop.

X-RAY TUBE UNIT

The x-ray tube unit consists of the x-ray tube with trunnions (**Figure 2-17**), the collimator, the rotary cuff all mounted on the control arm. The angle of the x-ray tube unit is adjustable about the support arm ±90° from the vertical axis. It can also be rotated in the trunnion ring +30° and -20°. The collimator is attached to the x-ray tube by a rotary cuff (**Figure 2-17**) and can be rotated ±90°.

To replace individual components of the x-ray tube unit, the vertical movement of the x-ray tube unit must be secured. To facilitate maintenance, push the x-ray tube unit all the way down until a pin or screwdriver can be inserted through the uppermost hole in the backside of the column, all the way through the column shaft, to secure the counterweight in place. Perform appropriate procedure(s) as follows:

COLLIMATOR

To replace the collimator, perform the following:

1. Remove two screws securing exterior cover and remove exterior cover (**Figure 2-18**).

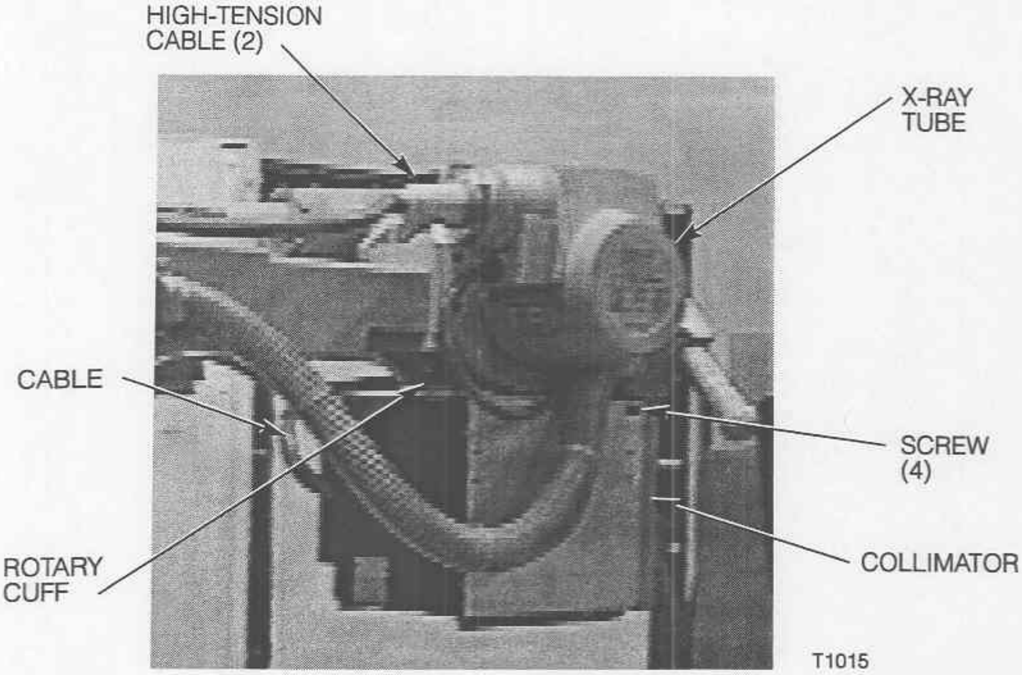

HIGH-TENSION CABLE (2)
X-RAY TUBE
CABLE
SCREW (4)
ROTARY CUFF
COLLIMATOR
T1015

FIGURE 2–17 X-RAY TUBE UNIT AND COLLIMATOR

2. Remove two hex head screws and two cap screws securing the interior cover (**Figure 2-19**).

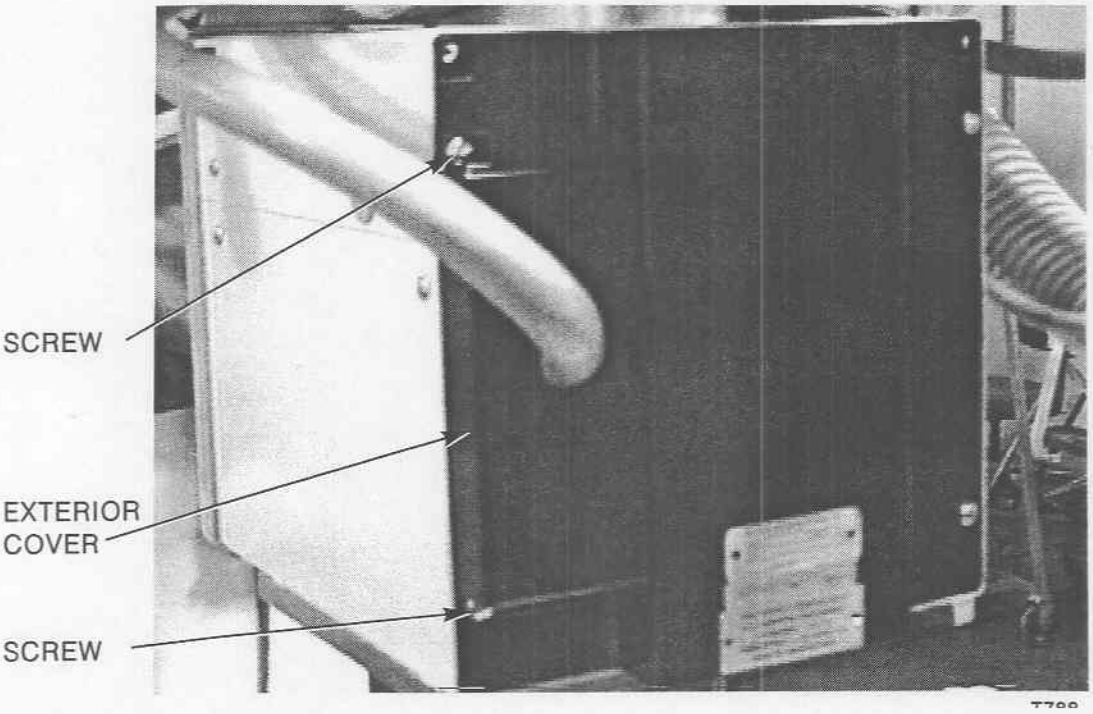

SCREW
EXTERIOR COVER
SCREW
T788

FIGURE 2–18 CABLE CONNECTOR COVER

3. Disconnect cable connected to collimator.

4. Loosen four screws and remove collimator from rotary cuff (**Figure 2-17**).

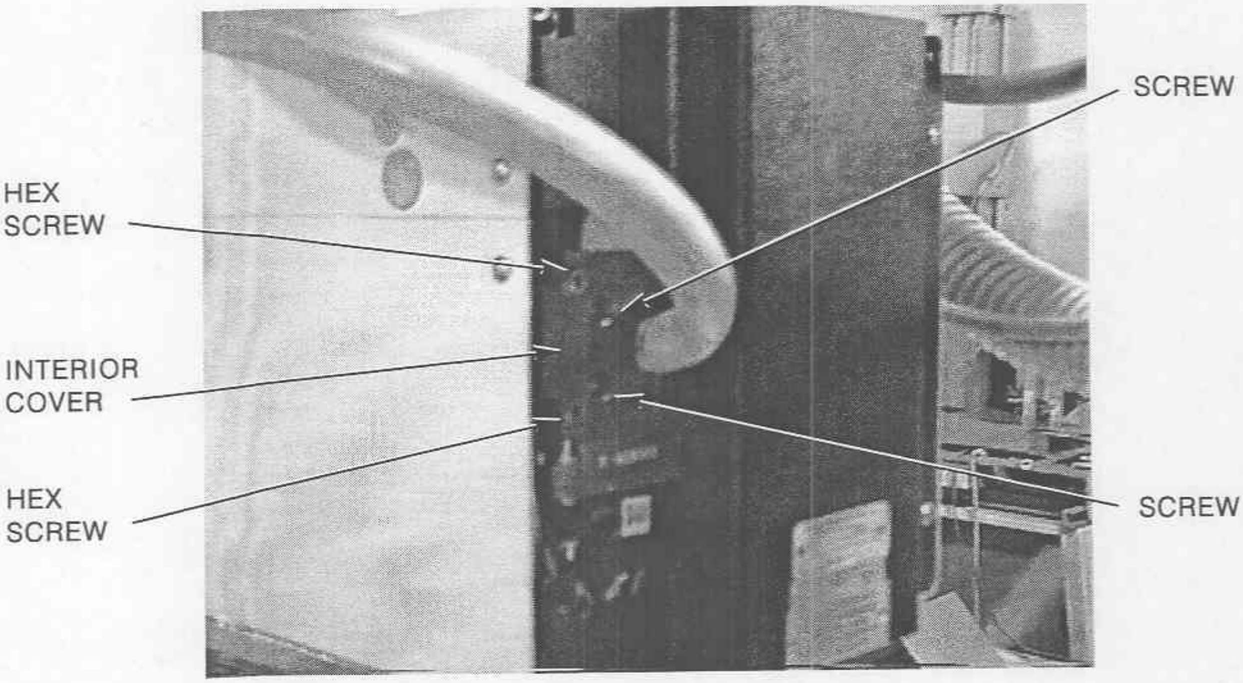


FIGURE 2–19 CONNECTOR PLUG COVER

5. Install replacement collimator.

6. Reverse steps for reassembly.

7. Refer to the **Collimator Technical Manual (SX008:TM)** to adjust the light beam to coincide with the x-ray beam.

X-RAY TUBE

To replace the x-ray tube, perform the following:

1. Remove collimator as described in the previous paragraph. Refer to **Figure 2-17**.

2. Disconnect the high-tension cables.

3. Remove four screws securing rotary cuff to x-ray tube unit and remove rotary cuff.

4. Remove the retaining screws and remove the upper halves of the right and left tube trunnion and lift the x-ray tube from the two lower trunnion halves.
5. Reverse steps for reassembly.
6. Refer to the **Collimator Technical Manual (SX008:TM)** to adjust the light beam to coincide with the x-ray beam.

REPLACEMENT OF BUCKY MOTOR

1. Remove the PCB cover toward the inside, after removing the three internal screws and loosening the three screws on the Bucky frame.
2. Disconnect connector P2 from PCB.
3. Remove the hex nut that connects the spindle nut with the angle piece on the grid frame.
4. Remove two screws securing the motor drive and remove the motor drive.

NOTE

Before remounting the motor drive, align the motor drive so that the two shift plates are centered between the light barriers on the PCB.

Check this adjustment by manually twisting the coupling.

5. Reverse steps for reassembly.

REPLACING THE PCB WITH THE MOTOR DRIVE

1. Remove the PCB cover toward the inside, by removing the three internal screws and loosening the three screws on the frame of the Bucky unit.
2. Remove ten screws securing the PCB to the motor drive.
3. Remove the hex nut that connects the spindle nut with the angle piece on the grid frame.
4. Cut the cable tie-wrap holding the cable harness.

5. Disconnect connector plug P1 from the PCB.

6. Place the cable harness with connector plug P1 out of the way.

7. Lift the grid frame from the right guides and then withdraw it from the left guide.

8. Swing out the PCB with the motor drive (lifting it upward along the right wall of the frame).

9. Reverse steps for reassembly.

THEORY OF OPERATION

INTRODUCTION

This section provides a brief description of the theory of operation of the Clinix VP4 table. This Theory of Operation makes reference to the circuit diagram 15649-S1/...

THEORY OF OPERATION

Transformer T1 (with jumpers that can be resoldered to operate on a line voltage of either 115 VAC or on 230 VAC), in conjunction with the bridge rectifier CR3 and capacitor C4, delivers a no-load voltage of 40 VDC

This DC voltage is stabilized by voltage regulator U1 and power transistor Q1. The DC voltage is adjustable by potentiometer R60.

Resistance R9 is the current-limiting resistance for the voltage regulator U1.

The motor is controlled through the H-bridge U16 (right and left direction).

The revolutions of the motor are transferred to the grid by means of a spindle.

The light barriers U7, U8, U10 and U11 are operated in synchronism with the grid movement. When light barriers U8 and U11 are actuated, the direction of the grid motion is reversed. When light barrier U10 is actuated, the Bucky moves into its home position. When the grid has moved approximately 8 mm from its home position, light barrier 7 is actuated and the Bucky contact closes.

When the exposure button at the generator is actuated, the Bucky is started with a line voltage of 115 VAC or 230 VAC at connection point P1-6 or at terminal strip TB 1-3. The optocoupler U3 switches through, so that the signal at its pin 5 becomes low. This low signal is applied to inputs 6 and 8 of gate U6. As a result, the signal at outputs 10 and 4 of gate U6 is high. The high signals are applied to the inputs 4 and 5 of the RS flip-flop U12.

The light barrier U8 is not actuated; as a result, the signal at its output is low. U5 (13, 12) inverts the low signal. The signal at input 3 of U12 (RS flip-flop) is then also high. The signal at input 2 of U12 is high because the signal at output 11 of U6 is high. U6 (11, 12, 13) inverts the high signal, so that the signal at output 11 of U6 is low and the signal at output 13 of U12 is high. As a result, the signals at inputs 2, 3, 4 and 5 of U12 are high. The signal at exit 1 of U12 is low and the signal at output 3 of U14 is high. The signals at inputs 8 and 9 of U14 are high. The signal at output 10 of U14 is low.

The signals at inputs 2, 4 and 6 of U13 are high, and the lower left transistor in the H-bridge U16 becomes conductive through R55, TP 4, the upper right transistor in the H-bridge U16 becomes conductive through U9 (3, 14), Q3 and U-15 (9, 11, 14, 10, 12, 15), and the grid moves toward the exposure position.

If the shift plate actuates the light barrier U8, the signal at its output becomes high, and the signal at the input of U12 becomes low through U5 (13, 12). The signal at output 1 of U12 becomes high and the motor is turned off.

The RS flip-flop U12 flips. The motor reverses its rotary direction, and after a reversal delay of 80 s is turned on again.

In standby, the signal at output 16 of U9 is low. As a result, the reference voltage of the voltage regulator U1 is subdivided through R14 and R114. With the Bucky start (line voltage 115 VAC or 230 VAC) at connection point P1-6 or at terminal strip TB 1-3, the signal at output 16 of U9 becomes high, and capacitor C5 is charged through R14, R16, so that the motor start is soft.

Simultaneously with the Bucky start, capacitor C10 is discharged through R19, R59, until the low signal at input 2 of U6 allows the gate to flip. The signal at output 3 of U6 becomes high, and the signal at output 16 of U96 becomes low. The signal at the $U_{nominal}$ input 5 of voltage regulator U1 becomes low again, and the motor runs slow again. This switching action occurs prior to the first rotary direction reversal of the motor.

Relay K1 for Bucky contacts K1A and K1B is triggered through the RS flip-flop U4 under the following conditions:

Transistor Q2 is closed when the proper line voltage is applied. The signal at input 1 of U5 is then high, and the signal at output 2 of U5 is low. The signal at output 4 of U5 is high, and, as a result, the signals at inputs 2 and 3 of U4 are also high.

TABLE 3-1 COMPONENT/FUNCTION

NAME	DRAWING/SQUARE	FUNCTION
K1		Bucky start relay
Coil	15649-S1 A11	Is actuated, if, at Bucky start, lie voltage is present and light barrier U7 is actuated.
Contact		
A	15649-S1 A12	Bucky contact. Connects plug connector contacts P1-1 and P1-2 or terminal points TB1-1 and TB1-2.
B	15649S1 A12	Bucky contact. Connects plug connector contacts P1-1 and P1-2 or terminal points TB1-1 and TB1-2.
R59	15649-S1 D3	Adjustment of the time during which the grid moves at high speed. The time is set at the factory.
R60	15649-S1 B6	Adjustment of the grid speed. The grid speed is set at the factory.

MAINTENANCE CHECK LIST & SCHEDULE

SAFETY INSPECTION

MECHANICAL

Check floor attachment bolts.
Check the screws of tube stand guide rails at 40 Nm.
Check wire ropes with attachment at a starting torque of 9 Nm.
Check screws of tube unit angulation brakes at a starting torque of 9 Nm.
Check the screws for attachment of the longitudinal tube stand brake at a starting torque of 9 Nm.

ELECTRICAL

Check function of longitudinal brake.
Check function of vertical brake.
Check function of angulation brake.

CLEANING AND LUBRICATION

Clean tabletop rails for the longitudinal movement.
Clean rails of intermediate frame.
Check brake bolts for longitudinal and transverse tabletop movement.
Clean rails of Bucky unit.
Clean upper guide rail of tube stand.
Clean lower guide rail of tube stand.
Check and clean rollers at front of column base.
Check and clean rollers at rear of column base.
Check and clean ball bearings for lateral guidance of column base.
Clean rails in the column.
Clean pulley.
Check and clean rollers of vertical carriage.
Check, clean and lubricate ball detent for angulation movement.

TESTS AND ADJUSTMENTS

Check rollers for longitudinal tabletop movement.
Check rollers for transverse tabletop movement.

Check and, if necessary, readjust brake release pedal bar for tabletop longitudinal and transverse movements. The braking force for the longitudinal and transverse movements must be 220 N.
Check Bucky longitudinal travel.
Check and, if necessary, readjust rollers for tube stand longitudinal travel.
Check and, if necessary, readjust longitudinal brake.
Check function of tube unit angulation brake.
Check wire ropes.
Check counterweight function.
Check vertical brake.

FUNCTIONAL TESTS

Check mechanical movements.
Check electrical functions.

MAINTENANCE SCHEDULE

The first scheduled maintenance is performed at 12 to 14 weeks after start up. Maintenance service shall be performed in accordance with the following schedule, **Table 4-1**.

TABLE 4-1 MAINTENANCE SCHEDULE

Maintenance#	1	2	3	4	5	6	7	8	9	10	11	12 & continued every $1^1/_2$ years
During year...after first use	$^1/_4$	1	$1^1/_2$	$2^1/_2$	$3^1/_2$	5	7	$8^1/_2$	$9^1/_2$	10	$11^1/_2$	
A. Inspection	X	X		X		X		X		X	X	
B. Lubrication			X		X	X	X	X		X	X	
C. Replacement	Replacement of parts subject to wear and tear											

Perform the second maintenance in the 11th or 12th month after first use, prior to expiration of the warranty.

INSPECTION

The inspection serves to implement the instructions in the Check List (Tests and Adjustments, and Function Tests).

LUBRICATION

All parts requiring lubrication and/or cleaning (e.g., bearing tracks, joints, ropes, chains, rollers, support rails) are listed in the Check list (Cleaning and Lubrication).

Roller bearings are lifetime-lubricated at the factor, so that no additional lubrication should be required in the longer term.

REPLACEMENT

Scheduled service must include replacement of parts that are subject to wear and tear. Mark each replacement with "X" in the Maintenance Check list or Safety Inspection Check list.

CASSETTE TRAY COMPONENT REPLACEMENT

NECESSARY TOOLS AND EQUIPMENT]

Besides the standard tools and cleaners (benzine, spirit, cloth) the following special tools and lubricants are required:

1. 0.9, 2, 3, 4 mm Hex keys
2. Screwdrivers for recessed-head screws, sizes 0 & 1
3. Socket wrenches, 5.5 & 7 mm
4. Open-end wrench, 5.5 mm
5. Omnia-Fit 80M, (screw glyptal) (Part No. 98.23.04)
6. Maintenance spray for special steel (Part No. 98.99.02)
7. Silicone spray (Part No. 98.13.06)
8. Rocol Ultraglide X5 (Part No. 98.xx.xx)

WARNING

HAZARDOUS VOLTAGES ARE PRESENT. OBSERVE ALL SAFETY PRECAUTIONS FOR WORKING WITH HAZARDOUS VOLTAGES. INSTALLATION WORK MUST NEVER BE PERFORMED WITH THE LINE VOLTAGE CONNECTED AND TURNED ON. FAILURE TO COMPLY MAY RESULT IN INJURY TO PERSONNEL.

ELECTRICAL COMPONENT COVER REPLACEMENT

Unscrew 4 screws (**Figure 5-1**) and remove electrical component cover by pulling it away from stop.

Installation of electrical component cover is the reverse of this procedure.

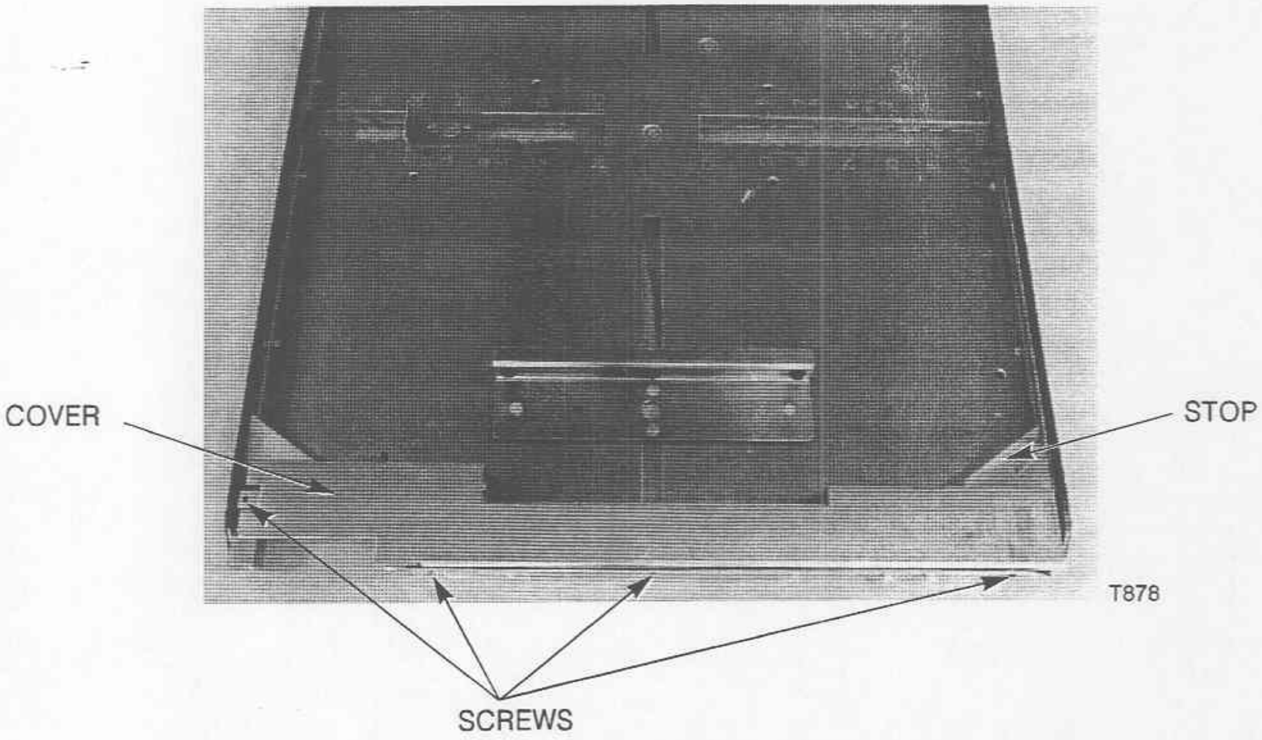


FIGURE 5-1 ELECTRICAL COMPONENT COVER

BOTTOM COVER REPLACEMENT

Unscrew 10 screws (**Figure 5-2**) and remove bottom cover.

Installation of bottom cover (**Figure 5-2**) is the reverse of this procedure.

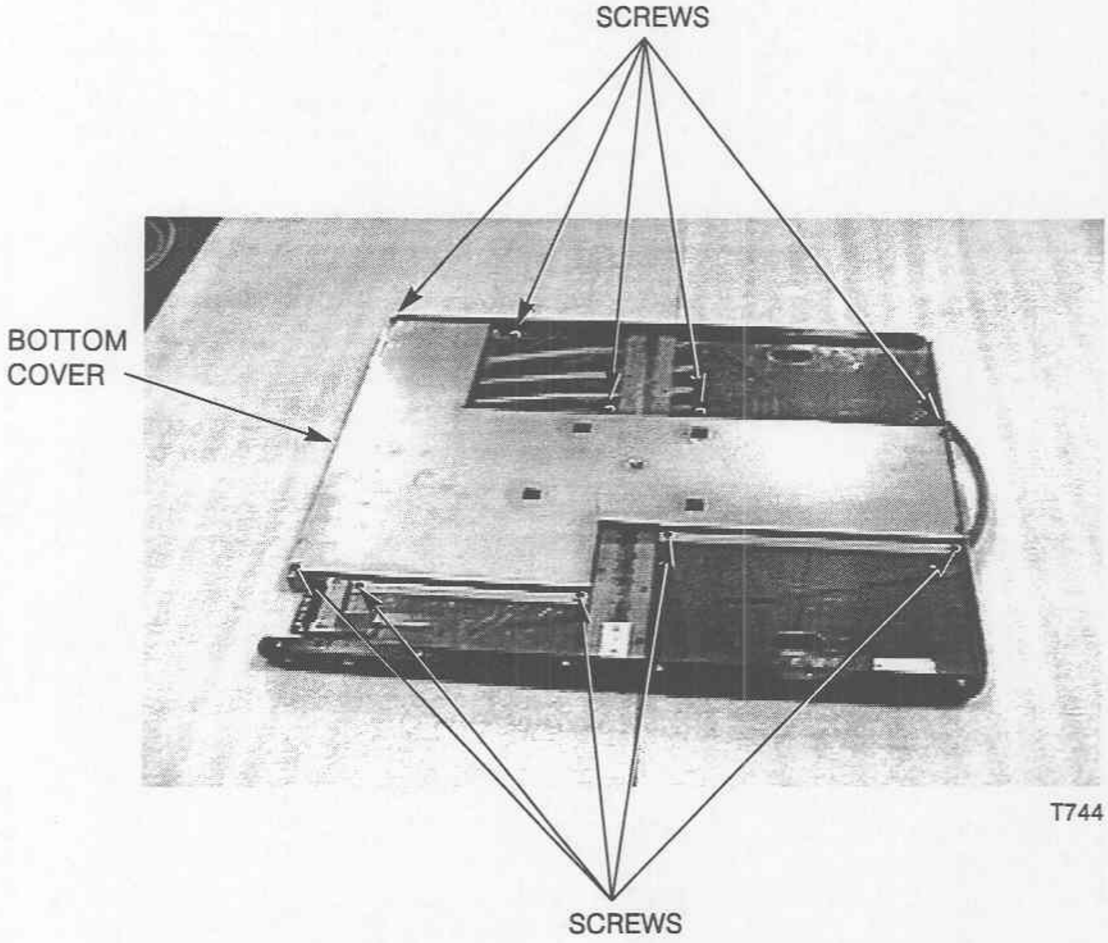


FIGURE 5-2 BOTTOM COVER SCREWS

WIDTH POTENTIOMETER REPLACEMENT

The width potentiometer R2 is mechanically connected to the side arm mechanism of the cassette tray. To replace the potentiometer R2 perform the following procedure.

REMOVAL

1. Loosen 2 set screws inside the pulley on the pot shaft (**Figure 5-3**) and remove the pulley from potentiometer shaft.
2. Loosen 2 countersunk screws (**Figure 5-4**).
3. Unsolder potentiometer leads.
4. Remove potentiometer.

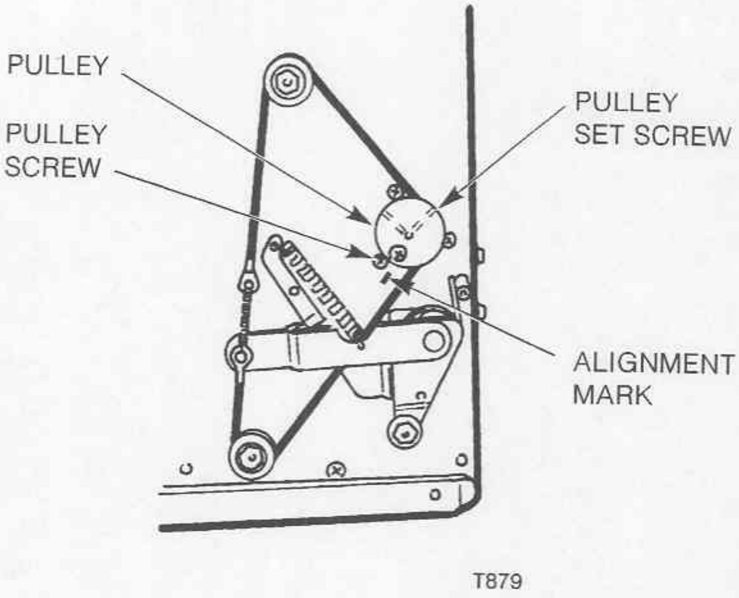

PULLEY
PULLEY SCREW
PULLEY SET SCREW
ALIGNMENT MARK
T879

FIGURE 5-3 WIDTH POT (R2) DRIVE

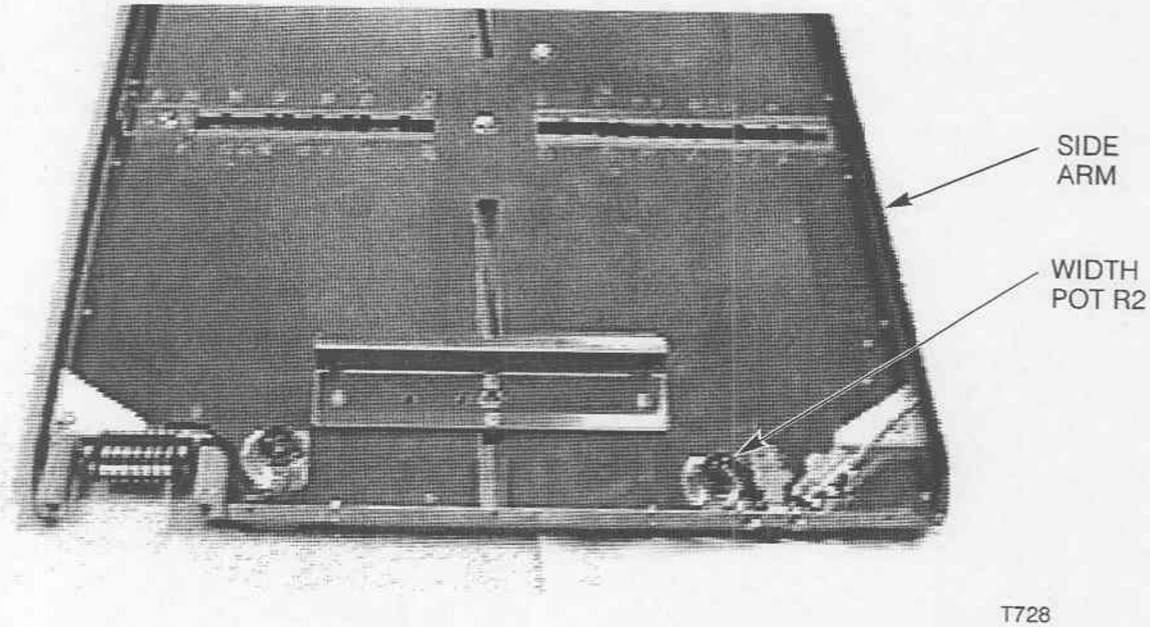

SIDE ARM
WIDTH POT R2
T728

FIGURE 5-4 WIDTH POT (R2) MOUNTING

INSTALLATION

1. Insert new potentiometer (**Figure 5-4**) and secure in place using 2 countersunk screws.
2. Install the pulley on the pot shaft (**Figure 5-3**), but do not tighten set screws at this time.
3. Align the screw in the pulley (**Figure 5-3**) with alignment mark on cassette tray.
4. Position the pulley on the pot shaft so that the space between cassette tray and the pulley is 1.0 to 1.5 mm.
5. Tighten the 2 pulley set screws.
6. Solder the potentiometer leads according to schematic diagram 15665–S1/...

ADJUSTMENT

1. Press side arm against cassette tray frame (see **Figure 5-4**).
2. Loosen the 2 countersunk pot holding screws.
3. Connect ohmmeter across pin 4 and pin 6 of cassette tray connector P3. Turn the pot to obtain 28 ohms.
4. Tighten the two mounting screws to secure the potentiometer in position.

LENGTH POTENTIOMETER R1 REPLACEMENT

The length potentiometer R1 is mechanically connected to the automatic centering and clamping device. To replace the potentiometer R1 perform the following procedure.

REMOVAL

1. Loosen the 2 pulley set screws (**Figure 5-5**) and remove the pulley from the potentiometer shaft.
2. Loosen the 2 countersunk screws that secure the pot mounting ring.
3. Unsolder the potentiometer leads.

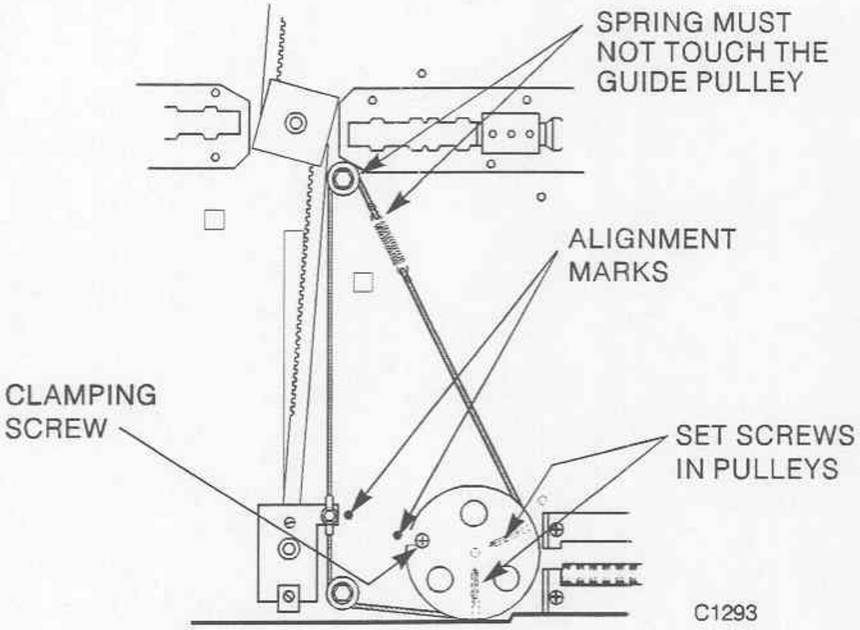

SPRING MUST NOT TOUCH THE GUIDE PULLEY
ALIGNMENT MARKS
CLAMPING SCREW
SET SCREWS IN PULLEYS
C1293

FIGURE 5-5 LENGTH POT R1 DRIVE MECHANISM

4. Remove potentiometer.

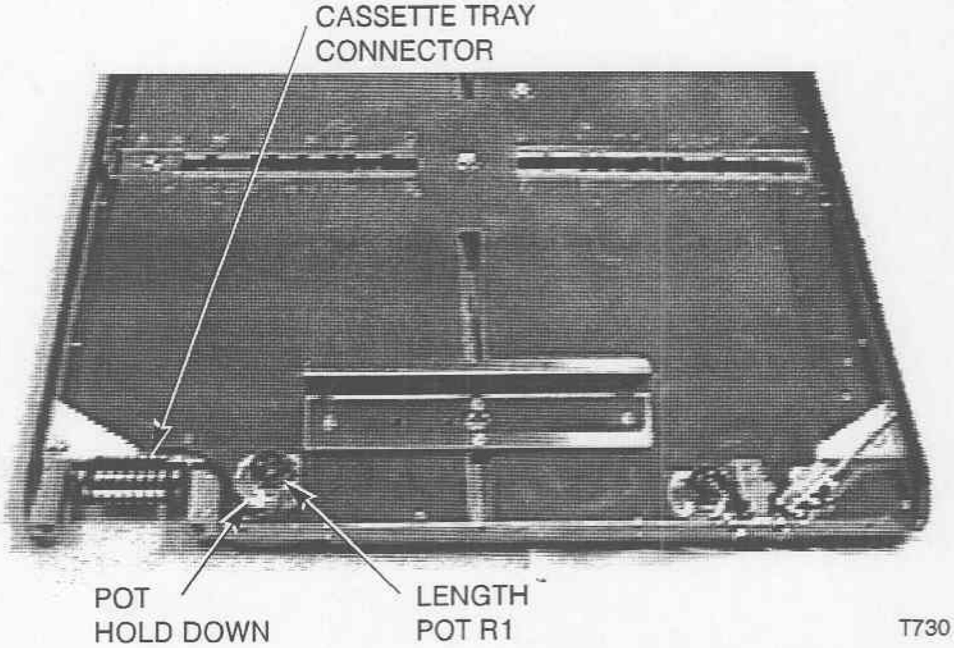

CASSETTE TRAY CONNECTOR
POT HOLD DOWN
LENGTH POT R1
T730

FIGURE 5-6 LENGTH POT R1

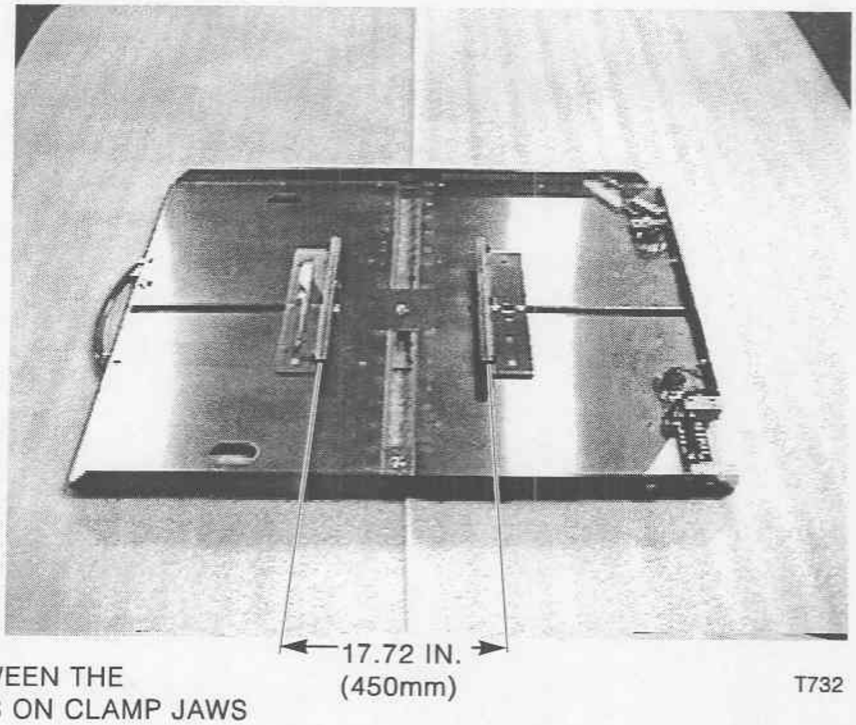
INSTALLATION

1. Insert new potentiometer (**Figure 5-6**) and secure in place using 2 countersunk screws.

2. Install the pulley on potentiometer shaft, but do not tighten set screws at this time.
3. Align the screw in the pulley (see **Figure 5-5**) and the cable attaching bolt in the slide with the respective alignment marks on cassette tray as shown in **Figure 5-5**.
4. Position the pulley so that the space between cassette tray and pulley is between 1 and 1.5 mm.
5. Tighten the 2 set screws inside the pulley.
6. Solder potentiometer leads according to schematic diagram 15665-S1/...

ADJUSTMENT

1. Open clamping jaws so that there is 458 mm between the rubber strips on the inside of the jaws as shown in **Figure 5-7**.
2. Loosen the 2 countersunk screws holding the pot.
3. Connect ohmmeter to pins 3 and 6 of cassette tray connector P3.
4. Turn the pot to obtain a reading of 28 ohms on the meter.
5. Secure potentiometer in place using 2 countersunk screws.



NOTE:
MEASURE BETWEEN THE
RUBBER STRIPS ON CLAMP JAWS

FIGURE 5-7 LENGTH POT ADJUSTMENT POSITION

CASSETTE CLAMP WIRE ROPE AND PULLEY REPLACEMENT

REMOVAL

1. Remove the bolt holding the wire rope lugs to the slide (see **Figure 5-8**).
2. Loosen screw in the pulley and remove rope from rope pulley as shown in **Figure 5-5**.
3. Loosen the 2 set screws and remove the rope pulley from the potentiometer shaft.

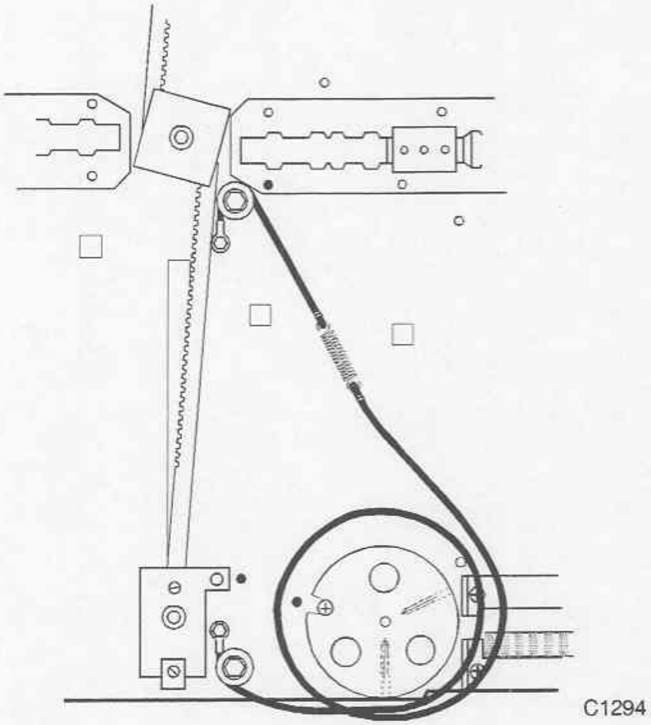


FIGURE 5-8 LENGTH POT WIRE ROPE REMOVAL

INSTALLATION

1. Install new rope pulley (**Figure 5-8**) on potentiometer shaft, but do not tighten set screws at this time.
2. Position the pulley so that the space between cassette tray and rope pulley is 1 to 1.5 mm.
3. Tighten the 2 set screws inside the rope pulley.
4. Fully open the clamp jaws
5. Wrap the wire ropes around the sheaves and the pot pulley (see **Figure 5-8**).
6. Hook the spring into the end lugs of the wire rope.
7. Attach the wire rope end lugs to the slide with the bolt.
8. Align the screw in the pot pulley and the slide bolt with their respective alignment marks on cassette tray as shown in **Figure 5-5**).

9. Tighten the clamping screw on the pot pulley.
10. Adjust the length adjustment pot (R1) according to the procedure earlier in this section.

FUNCTIONAL CHECK-OUT

1. Fully open the cassette clamp. The spring (**Figure 5-5**) must not touch upper sheave.
2. Fully close the cassette clamp. The lug at the spring must not touch the pulley.
3. Check the rope tension.

WIDTH POT WIRE ROPE AND PULLEY REPLACEMENT

REMOVAL

1. Remove the wire rope lug and spring from the lever (see **Figure 5-9**).
2. Loosen the clamping screw in the pulley (**Figure 5-9**) and remove the rope from the pulley (see **Figure 5-10**).
3. Loosen the 2 pulley set screws and remove rope pulley from the potentiometer shaft.

INSTALLATION

1. Install the new pulley on potentiometer shaft, but do not tighten the set screws at this time.
2. Position the pulley so that the space between cassette tray and rope pulley is 1 to 1.5 mm.
3. Tighten the 2 set screws inside the rope pulley.
4. Wrap the wire rope around sheaves and and rope pulley (see **Figure 5-9**).
5. Install the wire rope end lug and spring at the anchor bolt (**Figure 5-9**). Observe position of lever.

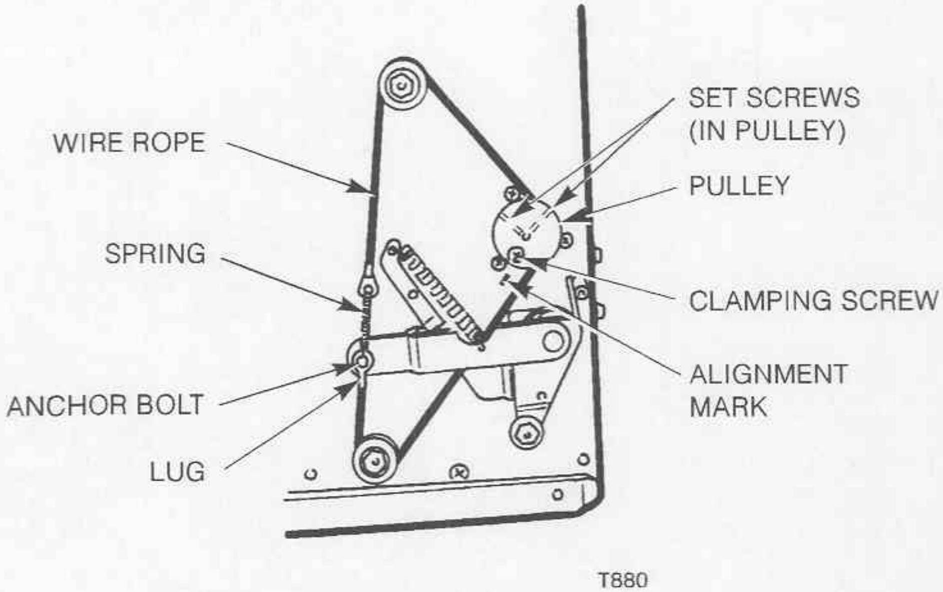

WIRE ROPE
SPRING
ANCHOR BOLT
LUG
SET SCREWS (IN PULLEY)
PULLEY
CLAMPING SCREW
ALIGNMENT MARK
T880

FIGURE 5-9 WIDTH POT WIRE ROPE

6. Align the pulley clamping screw (**Figure 5-9**) with alignment mark on cassette tray.

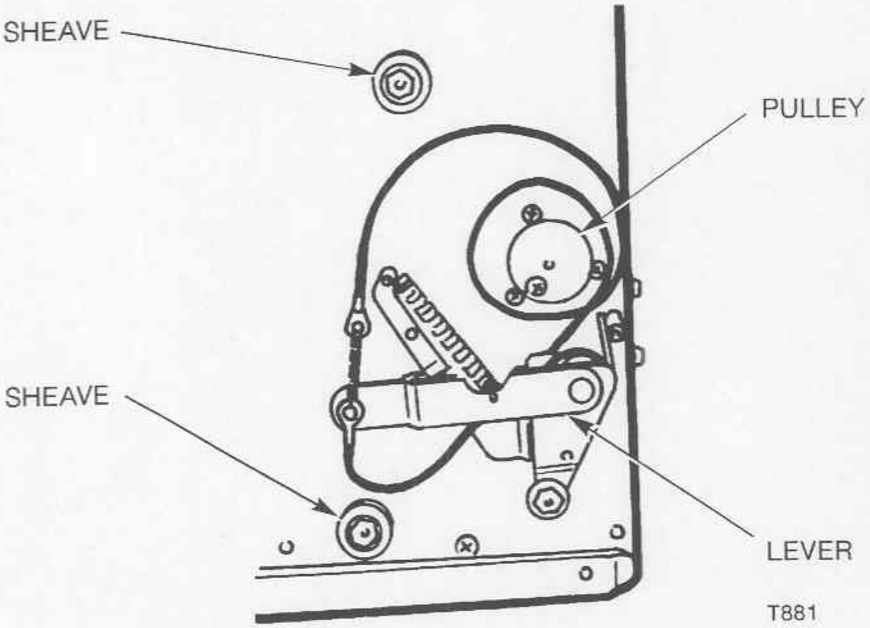

SHEAVE
PULLEY
SHEAVE
LEVER
T881

FIGURE 5-10 WIDTH WIRE ROPE REMOVAL

7. Tighten the clamping screw on the pulley.

POTENTIOMETER ADJUSTMENT

Adjust potentiometer R2 according to the procedure earlier in this section.

FUNCTIONAL CHECK-OUT

Check the wire rope tension and the function of side arm mechanism.

REPLACEMENT OF CASSETTE SIZING LEVER

REMOVAL AND INSTALLATION

1. Loosen the sizing lever attaching screws (**Figure 5-11**).

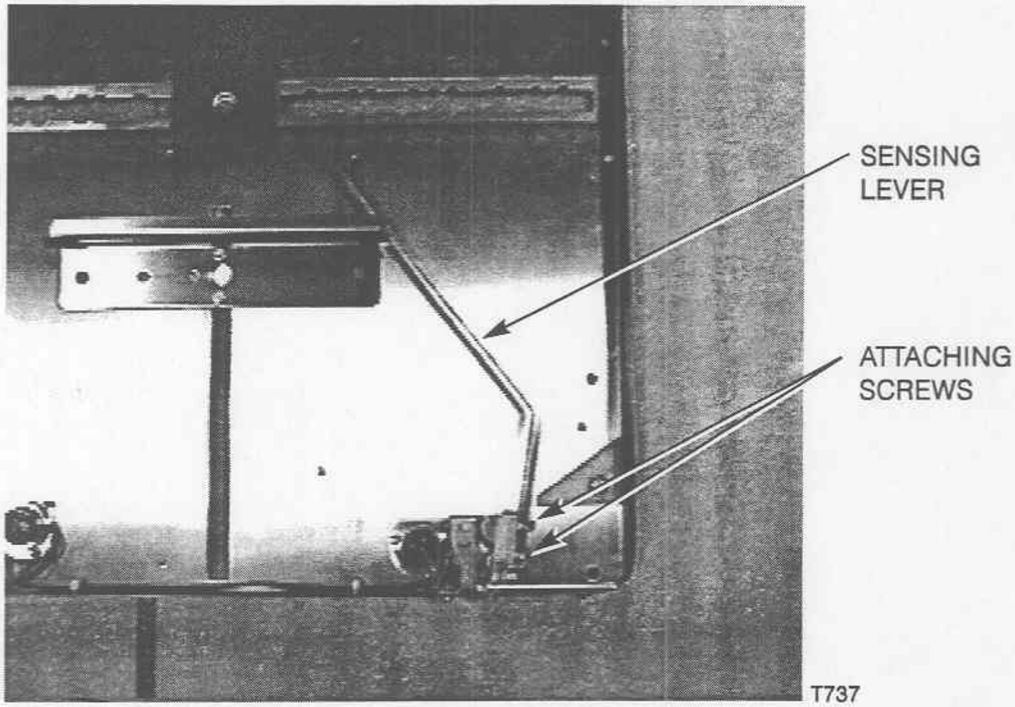
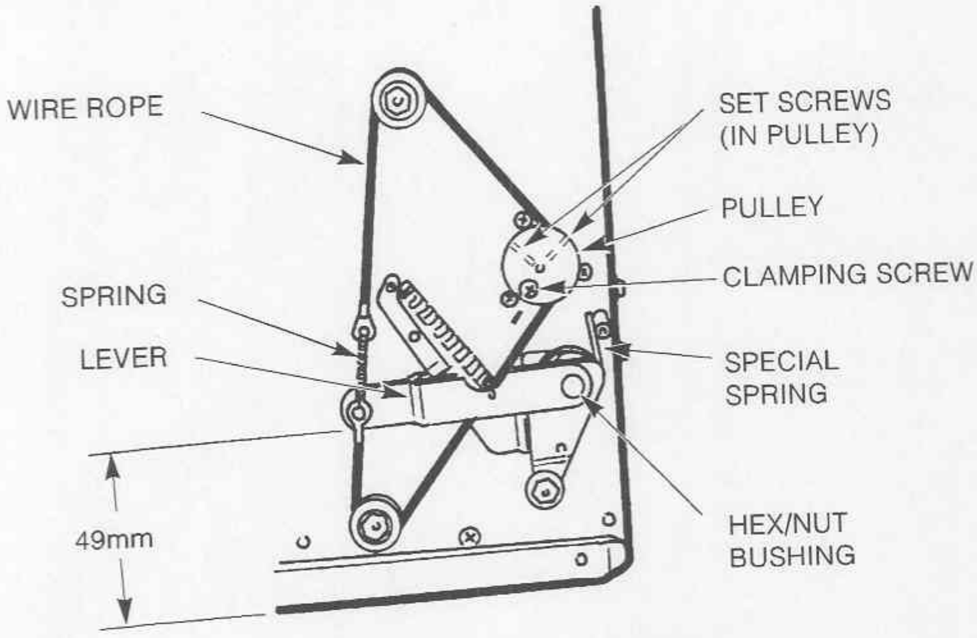


FIGURE 5-11 CASSETTE SIZE-SENSING LEVER

2. Remove the lever.
3. Remove the wire rope and spring (**Figure 5-12**).
4. Remove the lever with its spring and special spring (**Figure 5-12**).


WIRE ROPE
SET SCREWS
(IN PULLEY)
PULLEY
CLAMPING SCREW
SPRING
LEVER
SPECIAL
SPRING
49mm
HEX/NUT
BUSHING

T882

FIGURE 5-12 WIDTH SENSING MECHANISM

5. Unscrew the hexagon nut and remove the special bushing from the lever (**Figure 5-12**).

6. Installation of the lever is the reverse of this procedure.

LEVER ADJUSTMENT

1. Loosen the size-sensing lever attaching screws (**Figure 5-11**).

2. Loosen the 2 set screws inside the pulley (**Figure 5-12**).

3. Press the size-sensing lever against the side of the cassette tray frame.

4. Adjust the lever **(Figure 5-12**) to 49 mm as shown.

5. Align the clamping screw with the alignment mark on cassette tray as shown.

6. Position the pulley so that the space between cassette tray and rope pulley is 1.0 to 1.5 mm.

7. Tighten the 2 set screws inside the rope pulley.

8. Tighten the size-sensing lever attaching screws.
9. Adjust potentiometer R2 according to the adjustment procedure earlier in this section.
10. Check rope tension and function of side arm mechanism.

MICROSWITCH REPLACEMENT

REMOVAL

1. Unscrew the 2 microswitch bracket attaching screws (**Figure 5-13**) and remove the bracket with the microswitch.
2. Unsolder microswitch leads.
3. Unscrew the 2 attaching screws and remove the microswitch from the bracket.

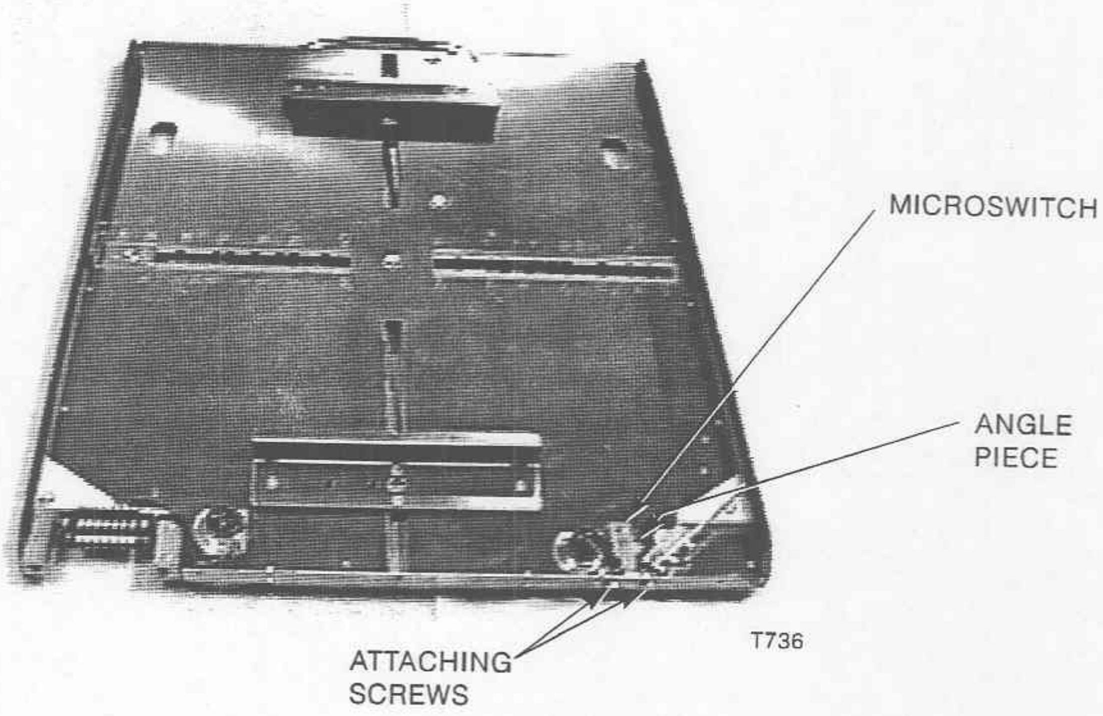


FIGURE 5-13 MICROSWITCH MOUNTING

INSTALLATION

1. Solder the microswitch leads according to schematic diagram 15665-S1/...

2. Install the new microswitch onto the bracket using 2 screws.

3. Install the microswitch mounting bracket onto the cassette tray using 2 screws.

MICROSWITCH AND LEVER ADJUSTMENT

1. The striker (**Figure 5-14**) actuates the cassette width sensing arm when cassette tray is inserted into Bucky cabinet.

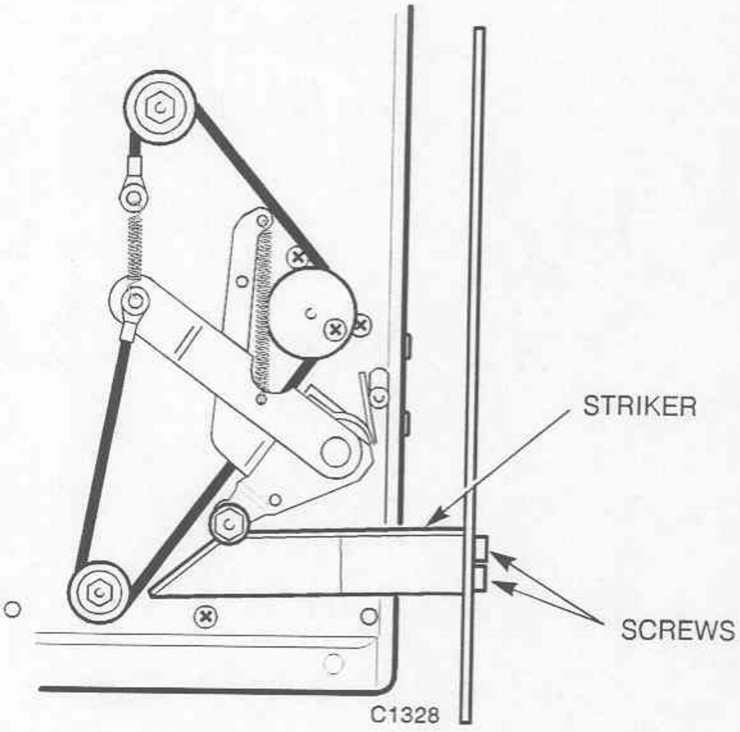


FIGURE 5-14 CASSETTE SIZING STRIKER INSERTION

2. Adjust the microswitch so that it switches when side arm is positioned above the 13 cm marking as shown in **Figure 5-15**). The "no cassette inserted" signal is present at the collimator control when the microswitch is actuated. The switching of the microswitch can be determined by connecting an ohmmeter to the switch.

3. Loosen as required the striker attaching screws, microswitch attaching screws or the size-sensing lever attaching screw to make the necessary adjustments.

4. Tighten the screws when the adjustment is finished.

5. Functional check-out. Without a cassette in place, insert the cassette tray 1 or 2 times into the bucky cabinet and check the switching of microswitch. This procedure can be checked using an ohmmeter.

NOTE

The microswitch must actuate before the cassette tray connector is inserted into the bucky cabinet receptacle to receive the signal "no cassette inserted".

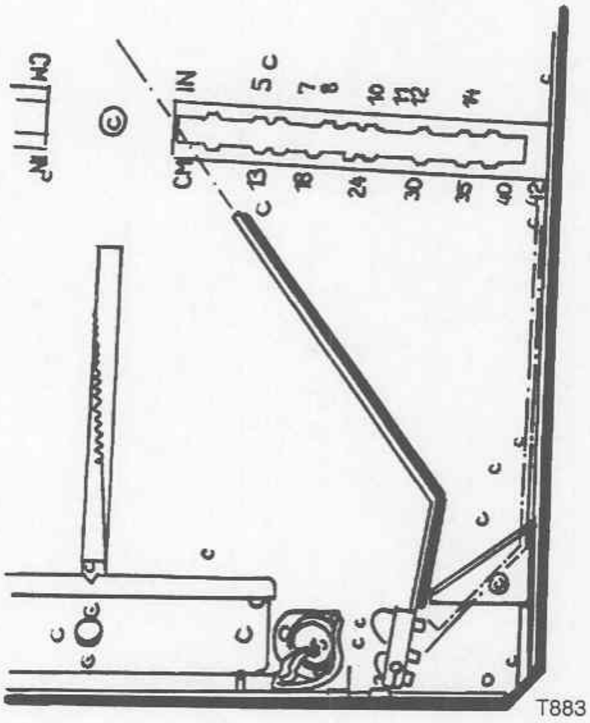


FIGURE 5-15 SENSING LEVER POSITION FOR ADJUSTMENT

SIDE SUPPORT REPLACEMENT

REMOVAL

1. Unscrew the 2 countersunk screws (**Figure 5-16**).
2. The plastic housing, spring and pushbutton will fall away on cassette tray underside.
3. Remove support finger.

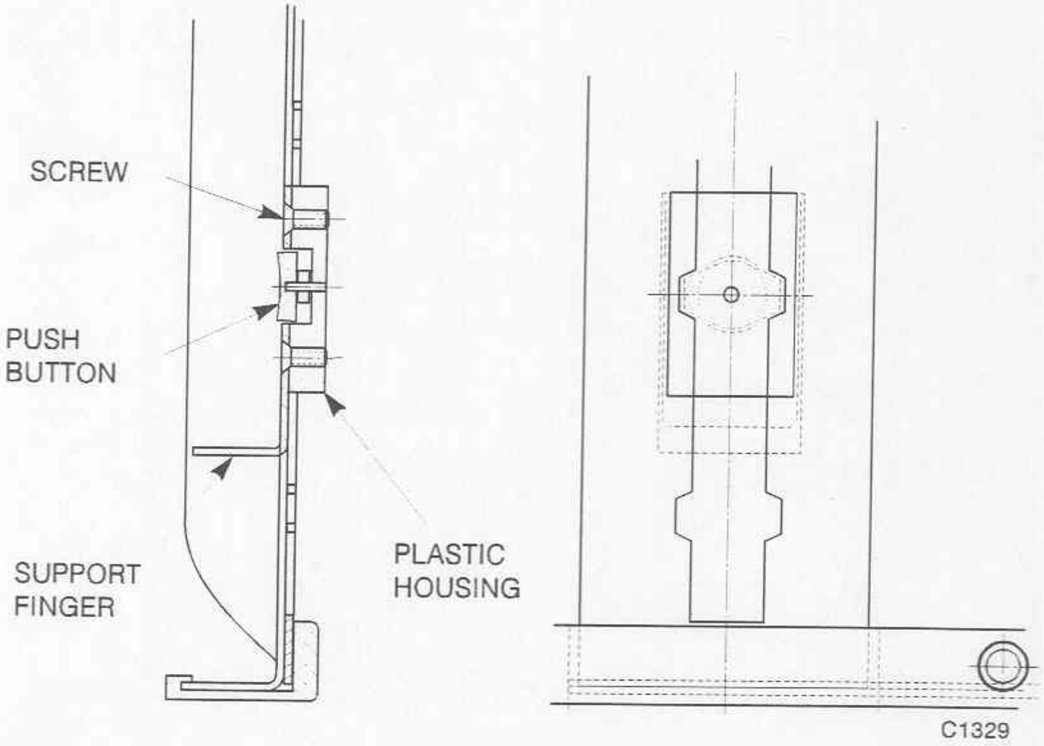


FIGURE 5-16 SIDE SUPPORT

MOUNTING

1. Insert the spring into the plastic housing (**Figure 5-16**) and insert the pin of pushbutton into the center of the spring and into the plastic housing.
2. Install the plastic housing, spring and pushbutton and position them in the slot so that the spring and pushbutton are trapped under cassette tray.
3. Align the support finger (**Figure 5-16**) with the holes in plastic housing and secure it in place using 2 countersunk screws.

4. Check that all of the parts move freely and check that the support finger locks in each detent.

PINION

REMOVAL AND INSTALLATION

1. Remove retaining ring (**Figure 5-18**), plate, washer, and pinion.
2. Lubricate new pinion.
3. Installation of new pinion is the reverse of this procedure.

CASSETTE CLAMP ADJUSTMENT

1. The distances between the end of each rack and the pinion (distances A and B in **Figure 5-17**) must be the same.

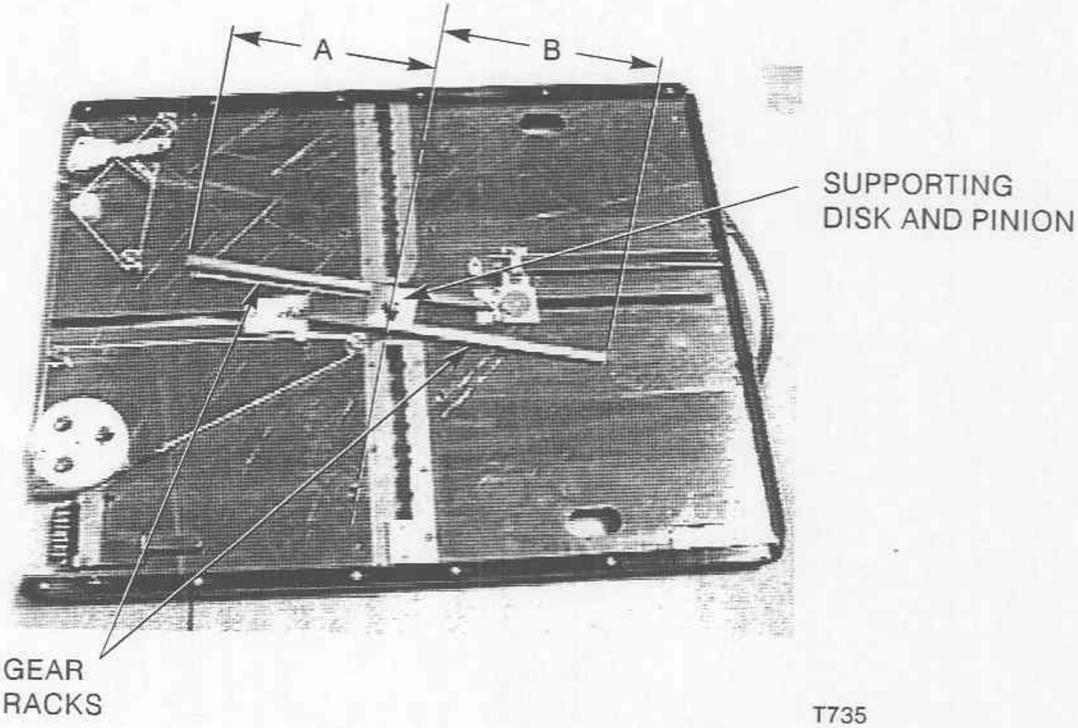


FIGURE 5-17 GEAR RACK CENTERING

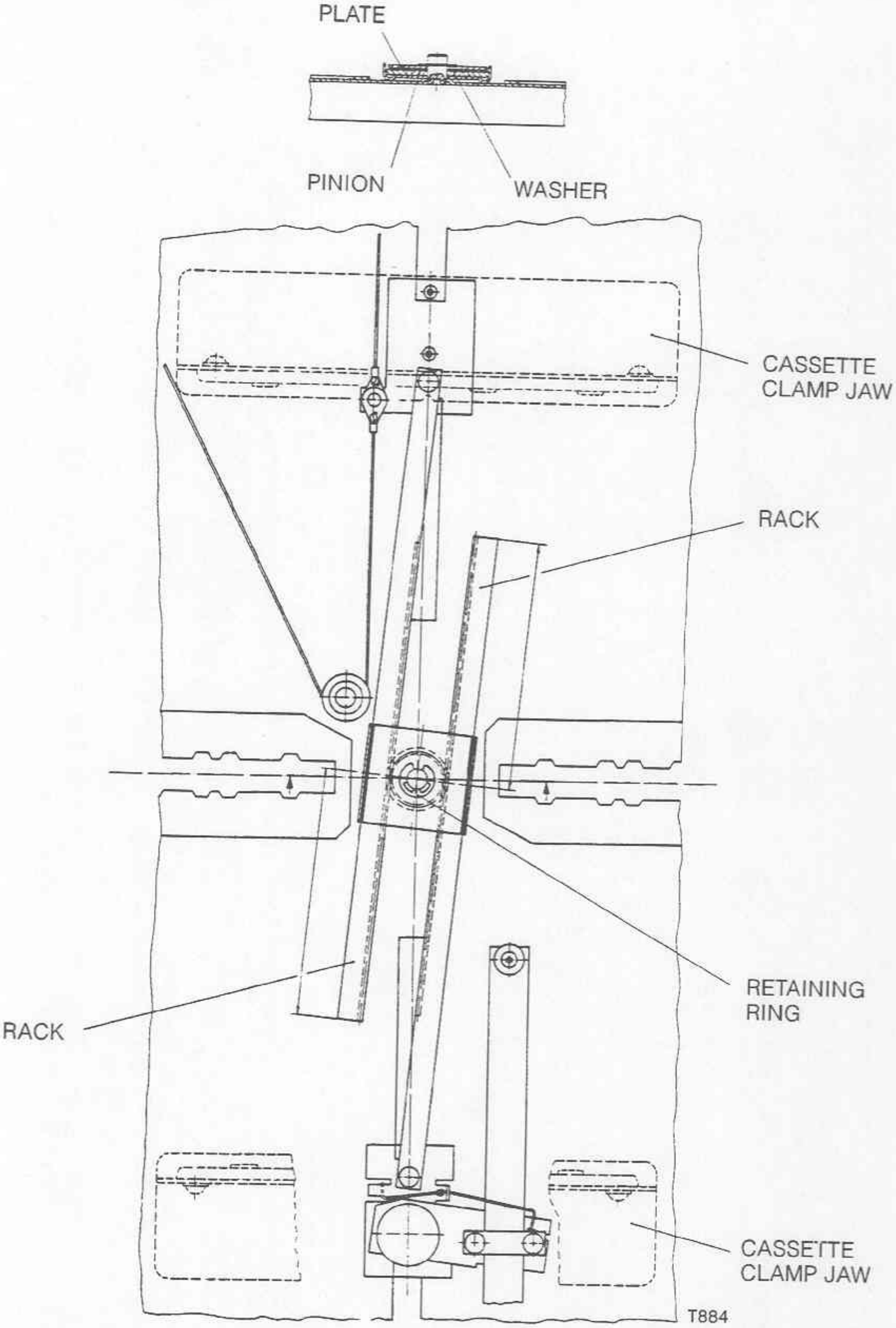


PLATE
PINION
WASHER
CASSETTE CLAMP JAW
RACK
RETAINING RING
RACK
CASSETTE CLAMP JAW
T884

FIGURE 5-18 CASSETTE CLAMP RACK AND PINION ASSEMBLY

CASSETTE CLAMP SLIDER AND SPRING REPLACEMENT

REMOVAL

1. Loosen the set screw (**Figure 5-19**) inside the clamping lever.
2. Remove the clamping lever from the eccentric bolt.
3. Remove the eccentric bolt and the slider.
4. Remove the spring.

INSTALLATION AND CASSETTE CLAMP ADJUSTMENT

1. Insert the slider into the rectangular opening of the plate (**Figure 5-19**).
2. While inserting the eccentric bolt observe the position of the surface at eccentric bolt.
3. Install the clamping lever on the eccentric bolt. The clamping lever must be in opening position.
4. Press the eccentric bolt (**Figure 5-19**) against cassette tray and fasten set screw.
5. Hook in the spring according to **Figure 5-19**.
6. Functional check-out. The front and rear clamp must move 2.5 mm while the clamping lever is being turned to the locked position.
7. Mark the clamping way on cassette tray for checking and measuring.

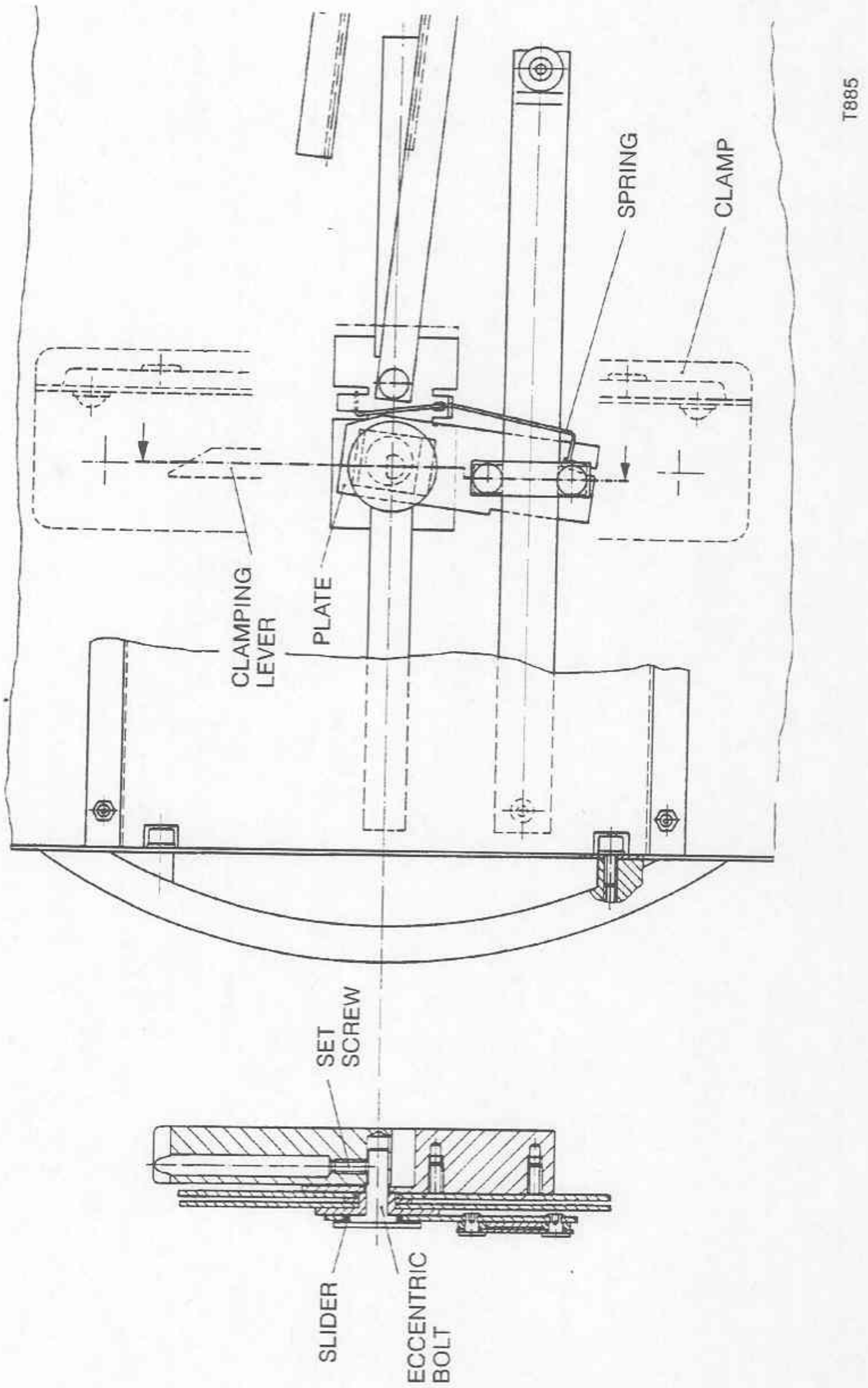

T885
SPRING
CLAMP
CLAMPING LEVER
PLATE
SET SCREW
SLIDER
ECCENTRIC BOLT

FIGURE 5-19 CASSETTE CLAMP SLIDER ASSEMBLY

CASSETTE TRAY CONNECTOR REMOVAL AND REPLACEMENT

REMOVAL

1. Unscrew the attaching screws and remove the stop (**Figure 5-20**).
2. Unsolder the leads from the cassette tray connector.
3. Unscrew the attaching screws and remove the cassette tray latch (**Figure 5-20**), cassette tray connector and strap.
4. Remove the cassette tray connector from cassette tray latch.

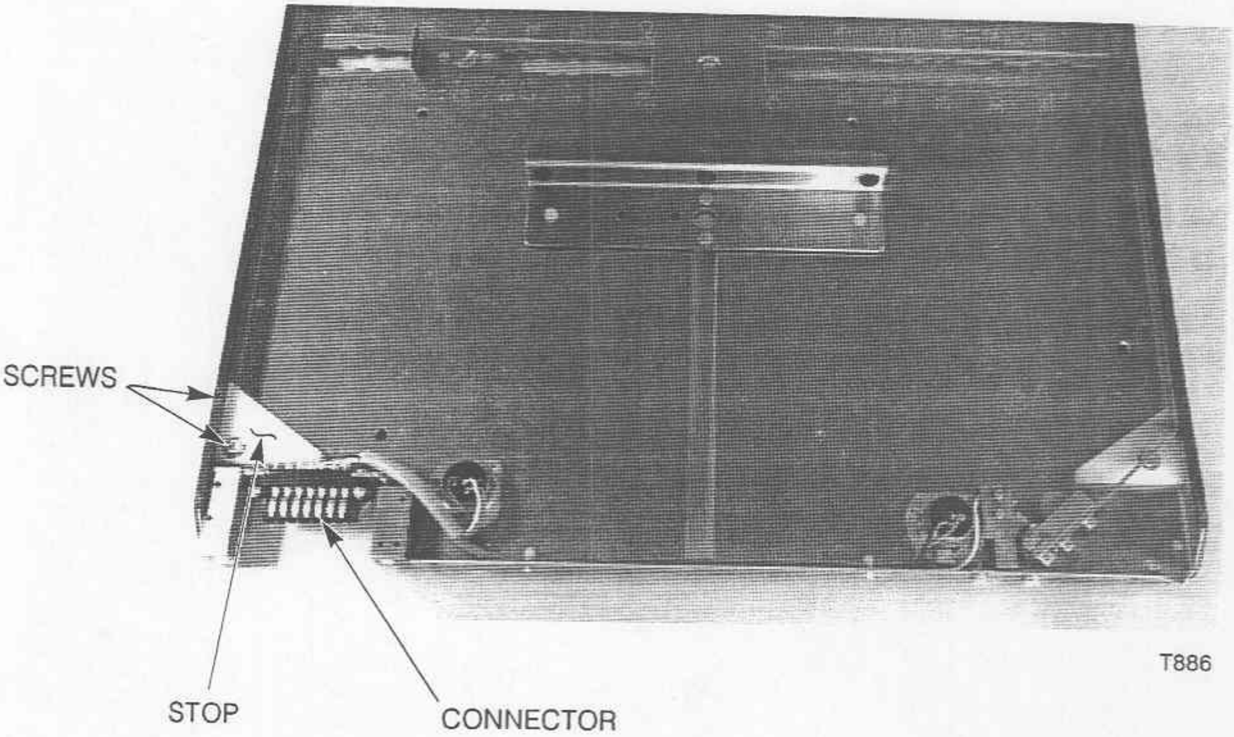


FIGURE 5-20 CASSETTE TRAY CONNECTOR

INSTALLATION

1. Install the cassette tray connector on cassette tray latch (**Figure 5-21**).
2. Solder cassette tray connector leads according to schematic diagram 15665-S1/...
3. Install the cassette tray latch (**Figure 5-21**) with cassette tray connector and strap.
4. Install the stop.

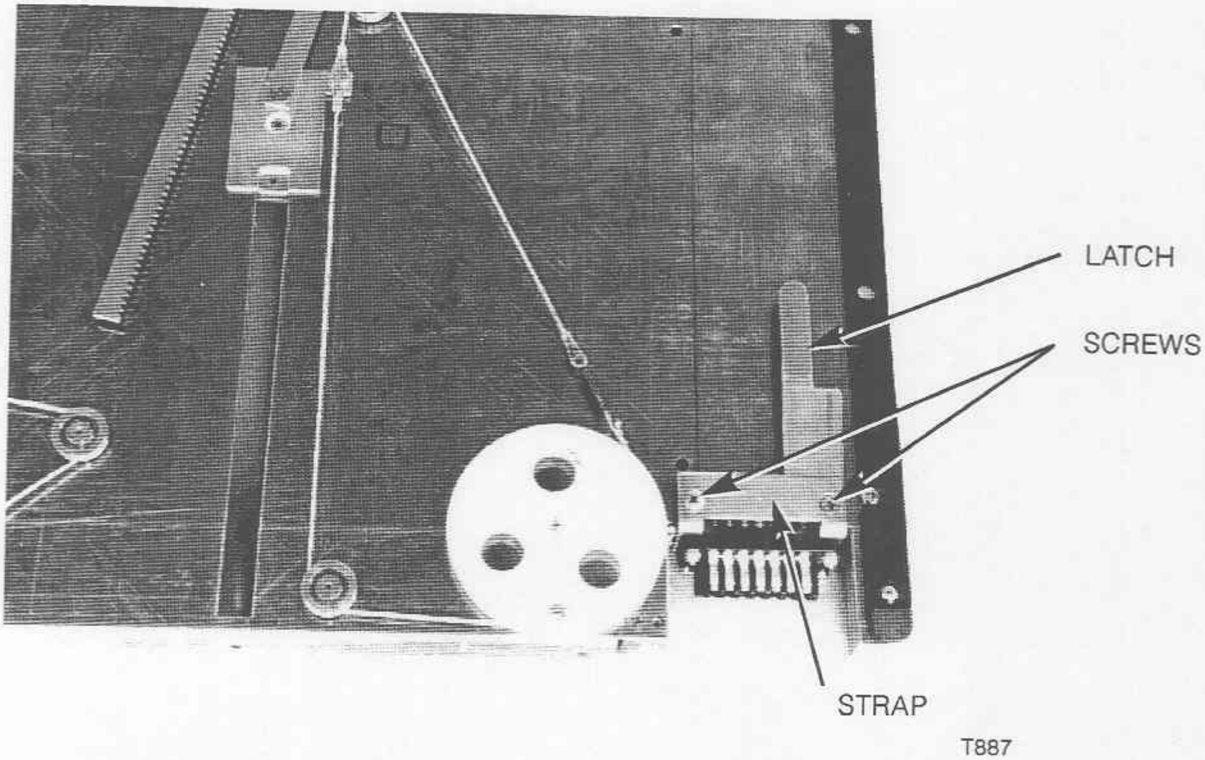


FIGURE 5-21 CASSETTE TRAY CONNECTOR DETAIL

BUCKY CABINET RECEPTACLE REPLACEMENT

REMOVAL

1. Unscrew the bucky cabinet receptacle plate attaching screws (**Figure 5-22**) and remove the plate from Bucky cabinet.
2. Unscrew the bracket attaching screws and remove the bracket from plate (**Figure 5-22**).
3. Unscrew the attaching screws (**Figure 5-22**) and remove bucky cabinet receptacle from the bracket.
4. Unsolder the bucky cabinet receptacle leads.

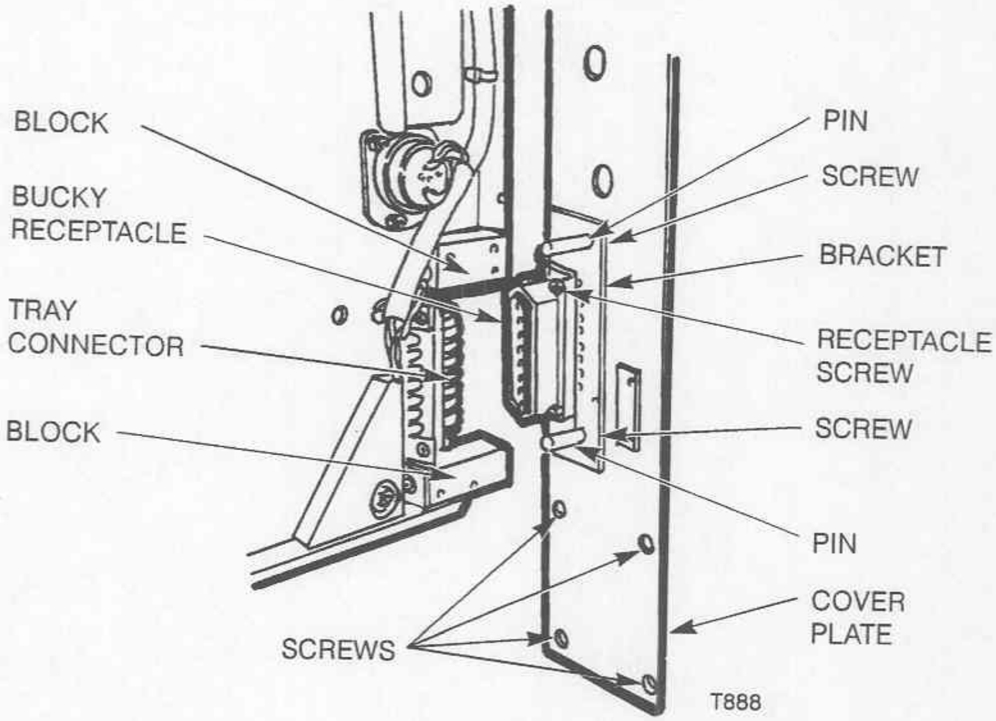

BLOCK
BUCKY RECEPTACLE
TRAY CONNECTOR
BLOCK
PIN
SCREW
BRACKET
RECEPTACLE SCREW
SCREW
PIN
COVER PLATE
SCREWS
T888

FIGURE 5-22 BUCKY CABINET RECEPTACLE

INSTALLATION

1. Solder Bucky cabinet receptacle leads according to schematic diagram 15665-S1 /. . .

2. Installation of Bucky cabinet receptacle is the reverse of the removal procedure.

3. Do not tighten the receptacle mounting screws until the conN"tÇInstall the cover plate on bucky cabinet. Leave the screws slightly loose.

ALIGNING CASSETTE TRAY CONNECTOR WITH BUCKY CABINET RECEPTACLE

1. The bracket must be movable on plate when the bracket screws are tightened (see **Figure 5-22**).

2. Install the cover plate on bucky cabinet. Leave the screws slightly loose.

3. Insert cassette tray into Bucky cabinet.

4. The connector must be aligned with the receptacle so that the pins go into the blocks (**Figure 5-22**) and cassette tray connector into the bucky cabinet receptacle when the cassette tray is inserted into the bucky cabinet.

5. Install the bucky cover plate.

6. Insert and remove cassette tray in the bucky cabinet a few times to check that it goes in and out with no binding.

SECURING THE CLINIX VP4 FOR TRANSPORT

INTRODUCTION

The Clinix VP4 system must be secured according to the following procedure before the shelter is transported. To secure the system for transport, the transverse tubearm assembly must be removed and placed in a special transport mounting device and the vertical column must be removed and secured to special mounting platforms on the baseplate. The following procedure describes how to perform these operations.

CAUTION

THE CLINIX VP4 SYSTEM MUST BE SECURED ACCORDING TO THE FOLLOWING PROCEDURE BEFORE THE SHELTER IS TRANSPORTED. FAILURE TO DO SO WILL RESULT IN DAMAGE TO THE EQUIPMENT.

PROCEDURE

1. Move the column to the head end of the table.
2. Move the tabletop all the way toward the foot end (right).
3. Place the foam pad on the head end of the tabletop as indicated in **Figure 6-1**.
4. Place the tube/collimator transport fixture on the foam pad as shown in **Figure 6-1**.

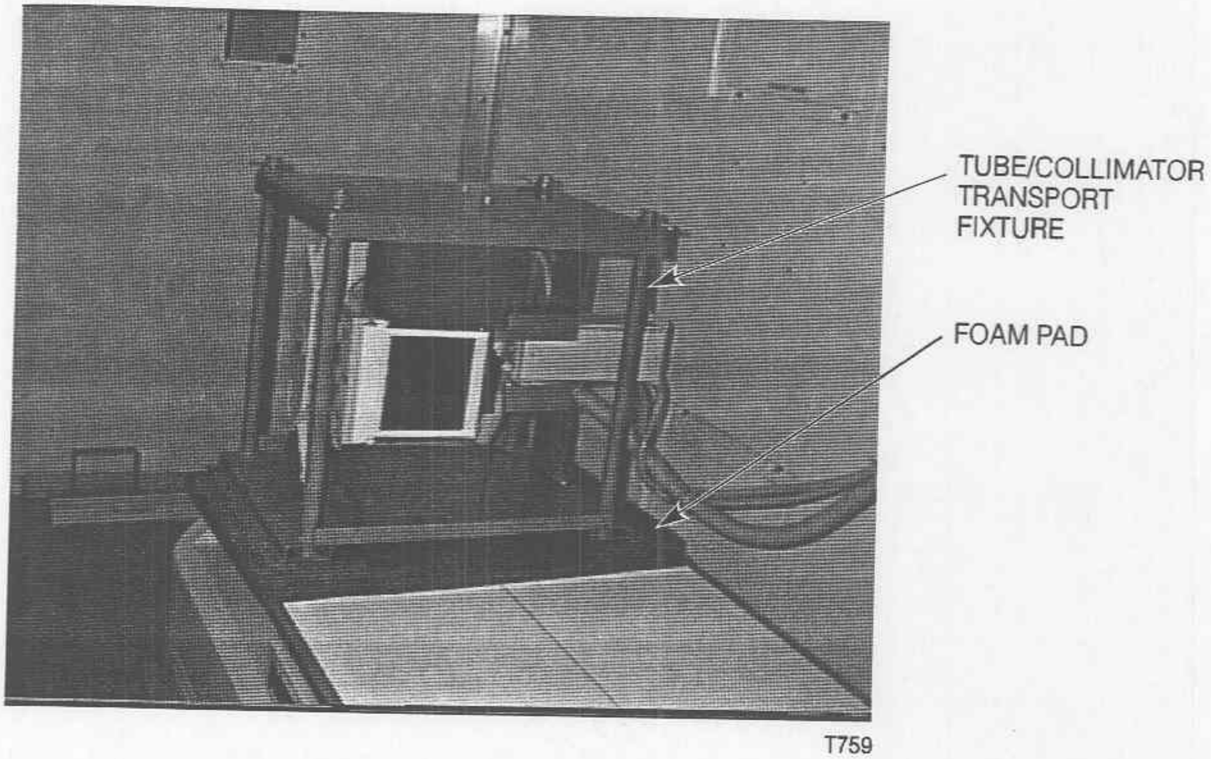

TUBE/COLLIMATOR TRANSPORT FIXTURE
FOAM PAD
T759

FIGURE 6-1 TUBE/COLLIMATOR TRANSPORT FIXTURE

5. Rotate the tube/collimator assembly so that the collimator is aimed toward the foot end as shown in **Figure 6-2**.

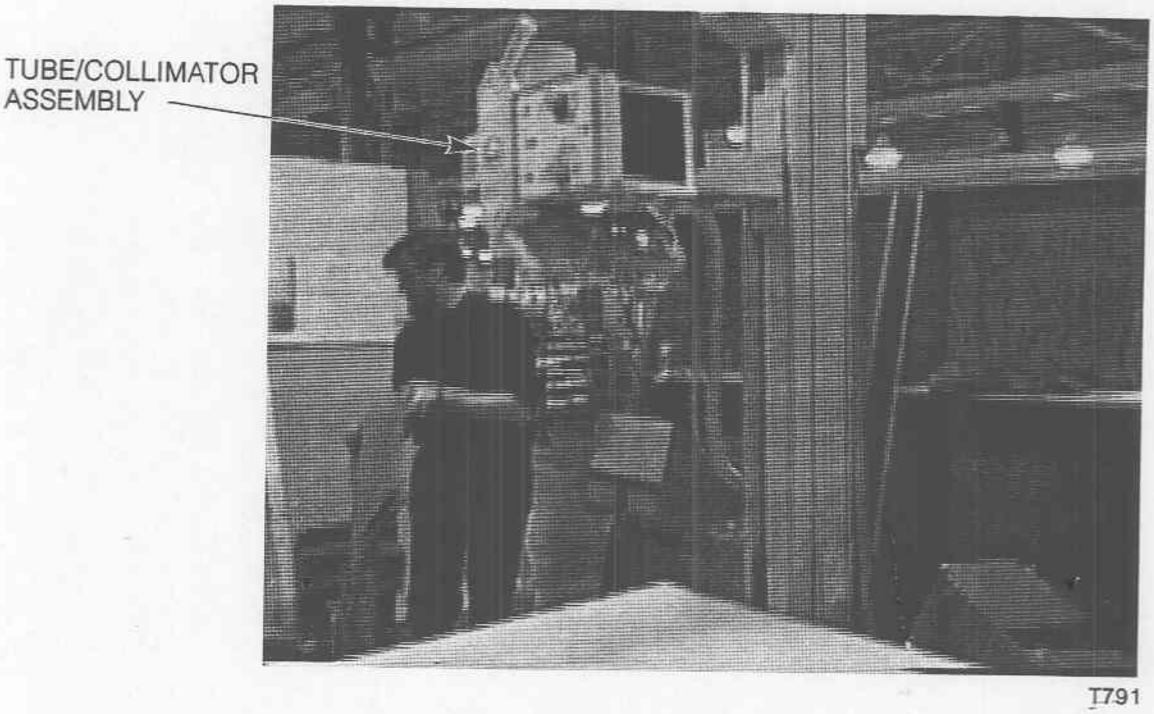

TUBE/COLLIMATOR ASSEMBLY
T791

FIGURE 6-2 TUBEHEAD POSITIONING FOR TRANSPORT

6. Lower tube/collimator assembly into the transport as shown in **Figure 6-3**.

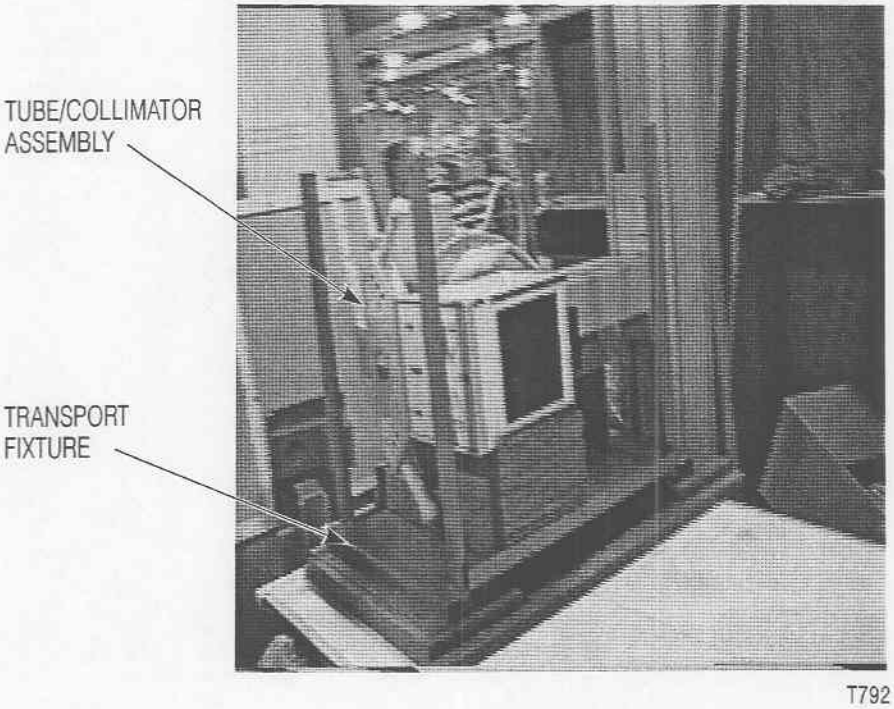


FIGURE 6-3 TUBE/COLLIMATOR PLACEMENT IN FIXTURE

7. Remove the counterweight support pin and bracket from the back of the vertical column (refer to **Figure 6-4**).
8. Insert the long end of the counterweight through the hole in the back of the vertical column and into the counterweight carriage inside the column.

NOTE

It may be necessary to move the tubearm up or down slightly to get the hole in the counterweight carraige to align with the hole in the column.

9. Remove four screws and lock washers securing the tubearm to the vertical carriage and push the tubearm in to its fully retracted position.
10. Move the tabletop forward away from the column.
11. Place the cover on the tube/collimator transport fixture.

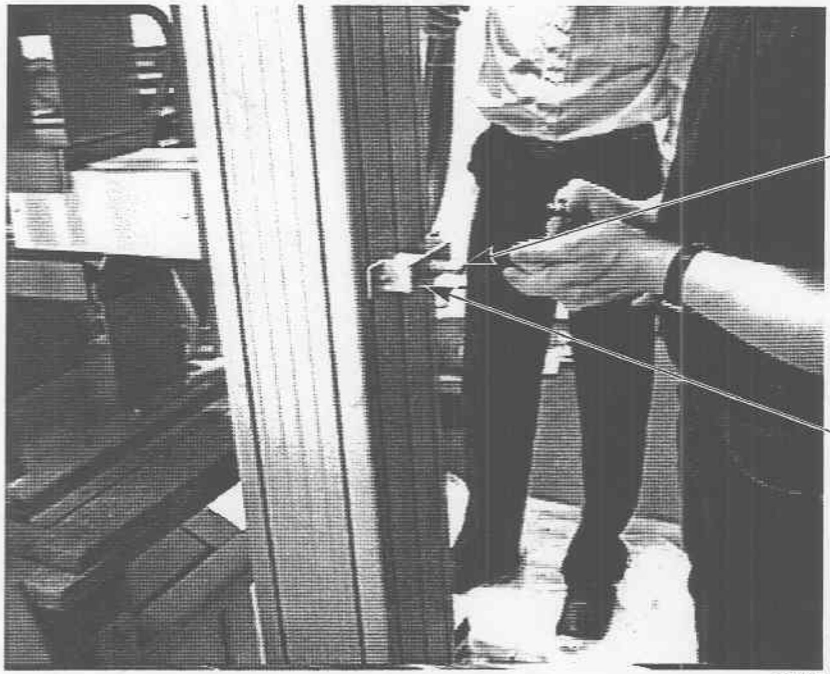

COUNTER-
WEIGHT
SUPPORT
PIN
COUNTER-
WEIGHT
SUPPORT
BRACKET
T769

FIGURE 6-4 COUNTERWEIGHT RESTRAINT PIN

12. Place one plastic spacer ring over each corner post and insert a clip in the top of each post as shown in **Figure 6-5**.

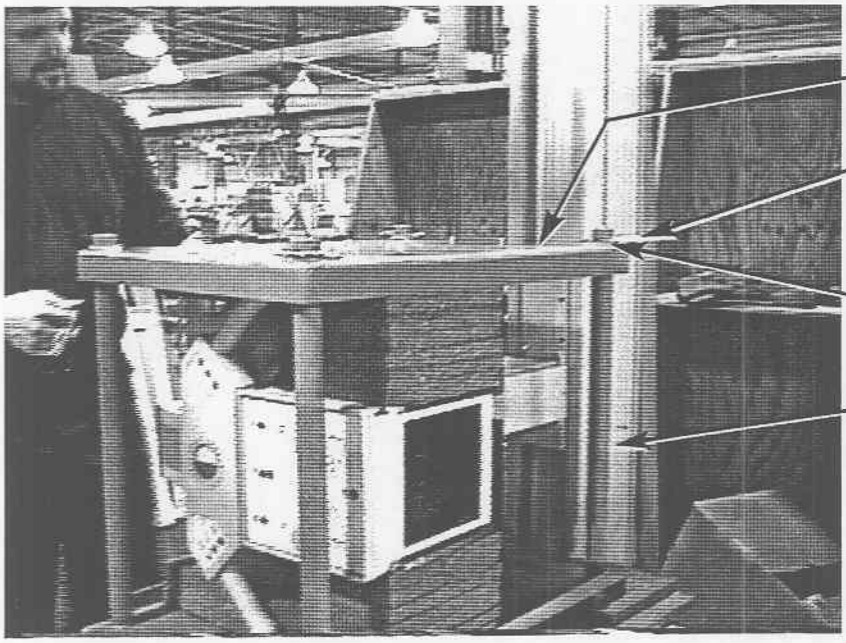

COVER
TOP CLIPS
SPACER
TUBE/
COLLIMATOR
TRANSPORT
FIXTURE
T770

FIGURE 6-5 COVER ON TRANSPORT FIXTURE

13. Position the vertical carriage lock so that the notch is over the setscrew as shown in **Figure 6-6**.

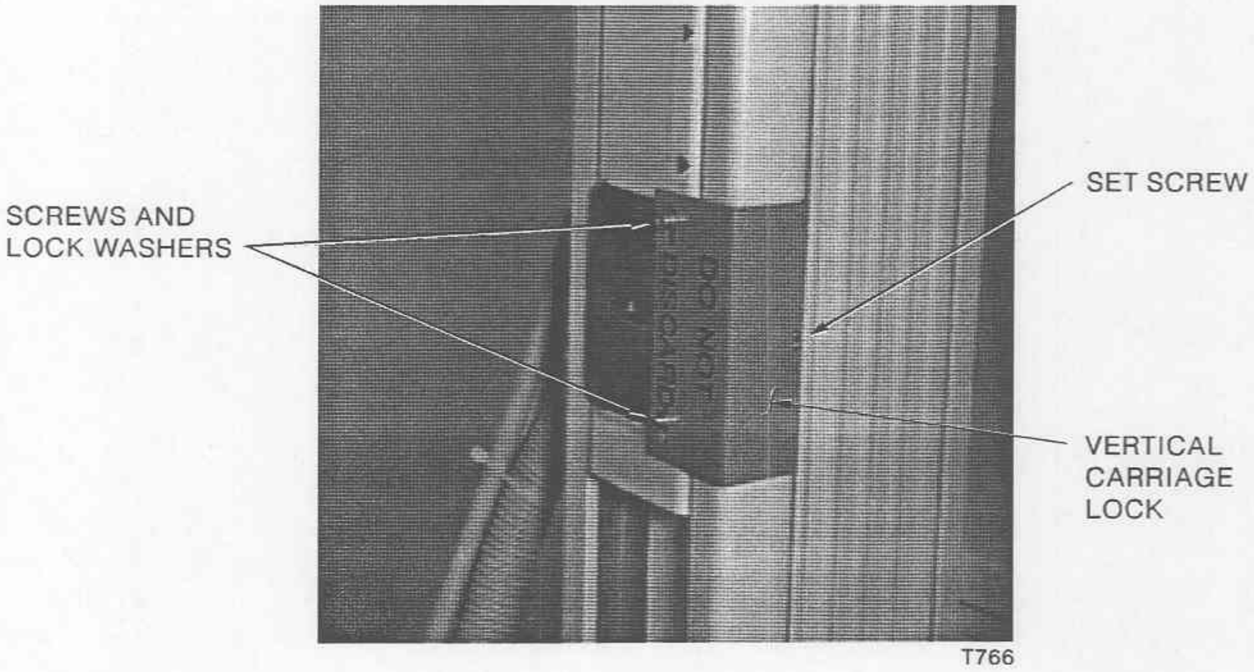

SCREWS AND LOCK WASHERS
SET SCREW
VERTICAL CARRIAGE LOCK
DO NOT DISCARD
T766

FIGURE 6-6 VERTICAL CARRIAGE RESTRAINT

14. Secure the vertical carriage lock in place using two screws and two lock washers.

15. Loosen the hole cover at the rear of the table and remove cable slack as shown in **Figure 6-7**.

16. Position the column all the way to the right on its travel (foot end).

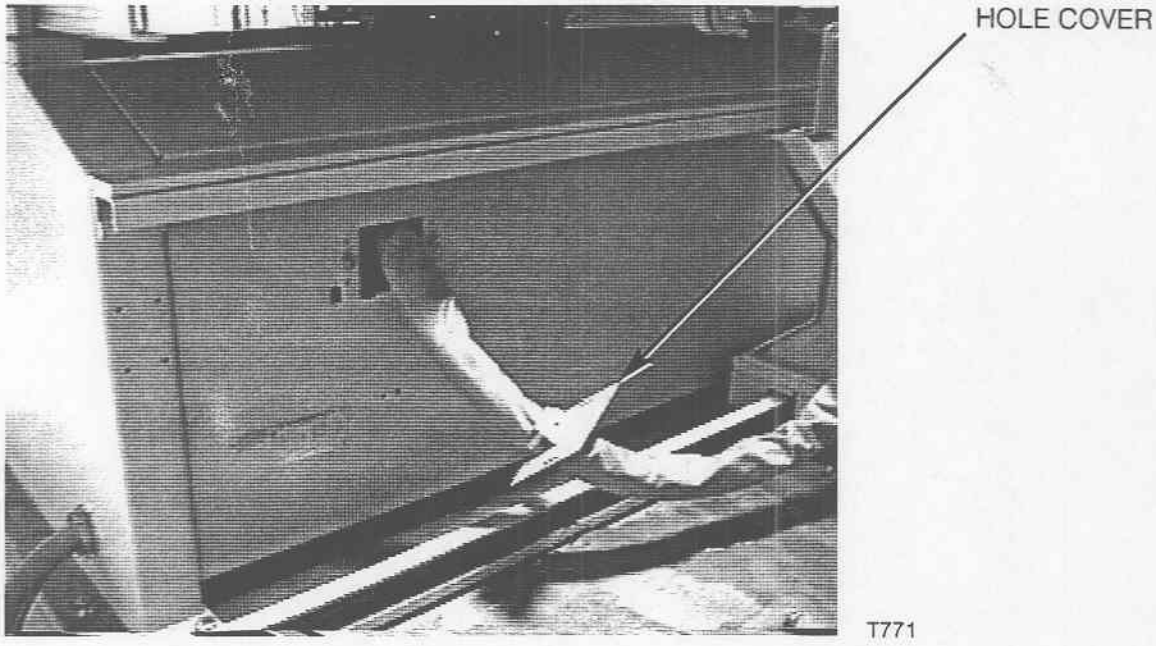

HOLE COVER
T771

FIGURE 6-7 TABLE CABLE COVER

17. Position the column support bracket to the baseplate as shown in **Figure 6-8** and secure in place using four screws and four lock washers.

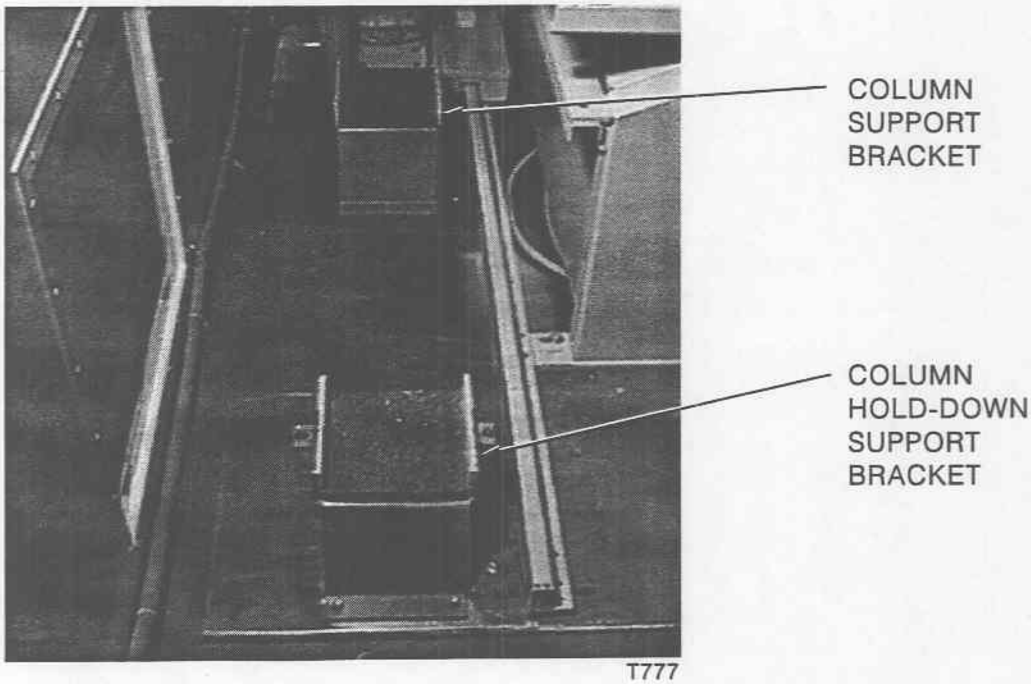

COLUMN SUPPORT BRACKET
COLUMN HOLD-DOWN SUPPORT BRACKET
T777

FIGURE 6-8 VERTICAL COLUMN TRANSPORT SUPPORTS

18. Position the column hold-down support bracket to the baseplate as shown in **Figure 6-8** and secure in place using four screws and four lock washers.

19. Lower the column hinge bracket and secure it to the column base using four screws and four lock washers as shown in **Figure 6-9**.

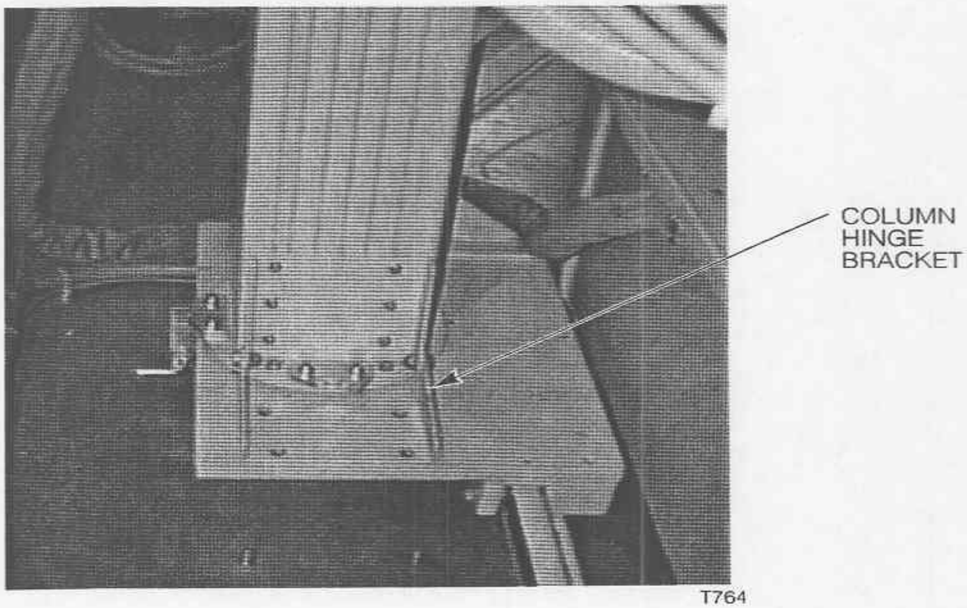


FIGURE 6-9 VERTICAL COLUMN HINGE INSTALLATION

20. Remove four screws that secure the column to the column base.

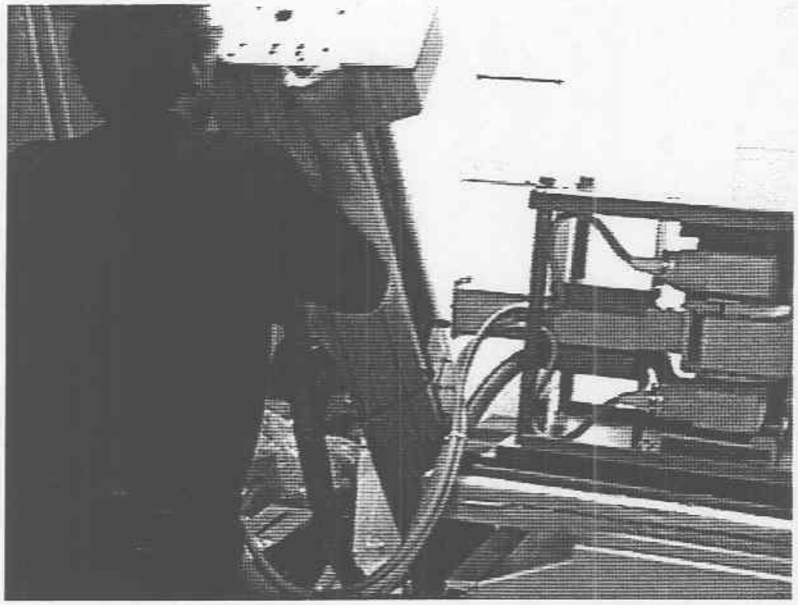
WARNING

THE COLUMN IS HEAVY. THEREFORE, USE EXTREME CAUTION WHILE LOWERING THE COLUMN ONTO THE COLUMN SUPPORT BRACKETS, OTHERWISE, PERSONAL INJURY MAY RESULT.

CAUTION

ENSURE THAT THE CABLES DO NOT BECOME TRAPPED BETWEEN THE COLUMN AND THE SUPPORT BRACKETS. OTHERWISE, DAMAGE TO THE CABLES MAY RESULT.

21. While making sure that the cables do not come between the vertical column and the support brackets, lay the column down on the support brackets as shown in **Figure 6-10**.



T762

FIGURE 6-10 LOWERING THE VERTICAL COLUMN

22. Position the column hold-down bracket to the hold-down support bracket over the column as shown in **Figure 6-11**.

23. Secure the column hold-down bracket in place using two screws and two lock washers.

WARNING

THE LOADED TRANSPORT FIXTURE IS HEAVY. THEREFORE, USE EXTREME CAUTION WHILE LIFTING OR MOVING THE TRANSPORT FIXTURE, OTHERWISE, PERSONAL INJURY MAY RESULT.

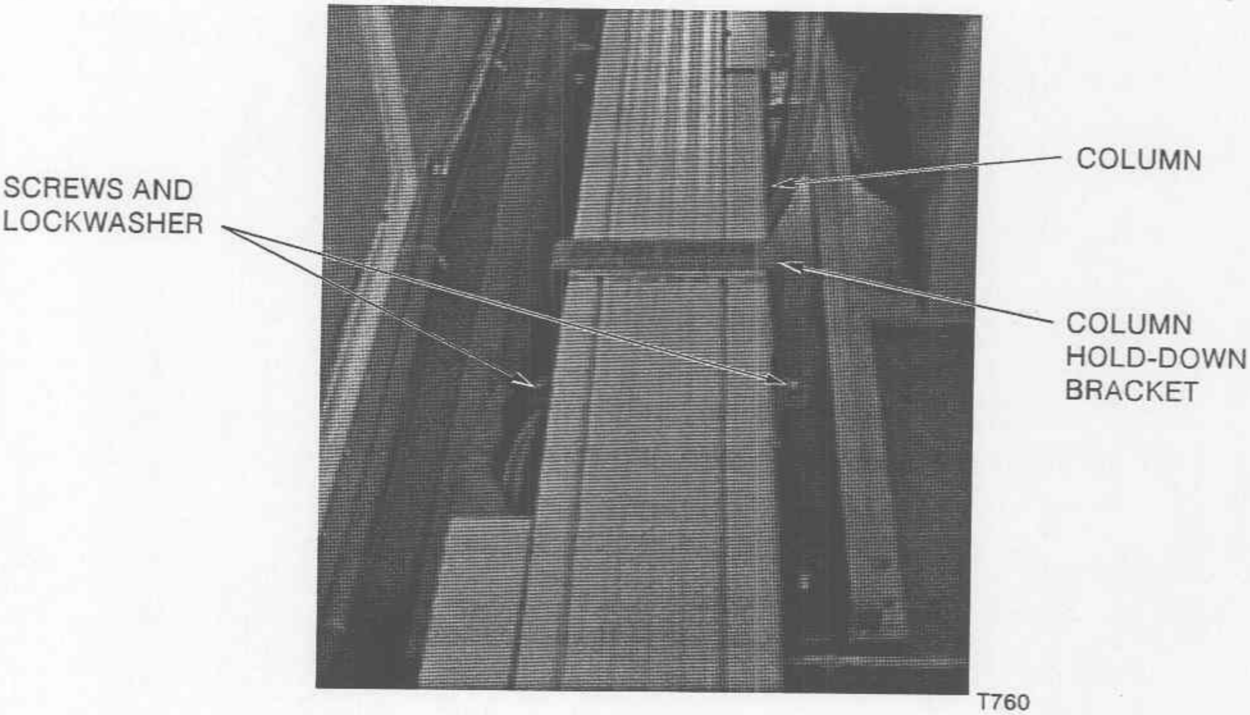

SCREWS AND
LOCKWASHER
COLUMN
COLUMN
HOLD-DOWN
BRACKET
T760

FIGURE 6-11 INSTALLING COLUMN HOLD-DOWN BRACKET

24. Lift the tube/collimator transport fixture off of the table and set it on the baseplate near the table base as shown in **Figure 6-12**.

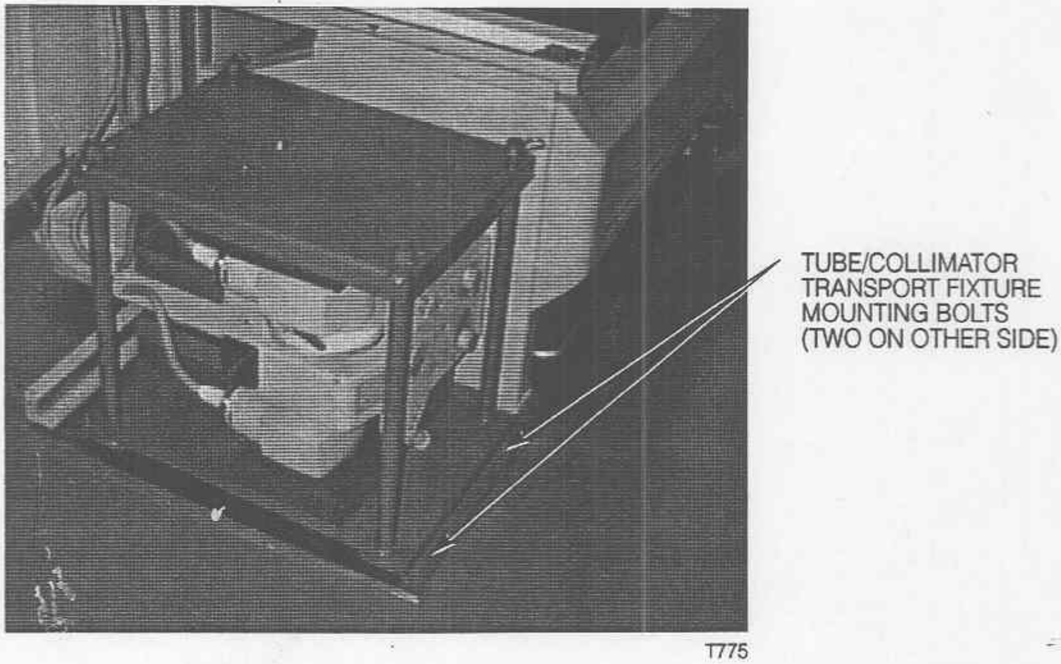

TUBE/COLLIMATOR
TRANSPORT FIXTURE
MOUNTING BOLTS
(TWO ON OTHER SIDE)
T775

FIGURE 6-12 TUBE/COLL.TRANSPORT DEVICE PLACEMENT

25. Secure the fixture to the baseplate using four screws and four lock washers.

26. Move the tabletop to the middle position.

27. At the rear of the bucky, hook bucky restraint cord to the guide rail as shown in **Figure 6-13**.

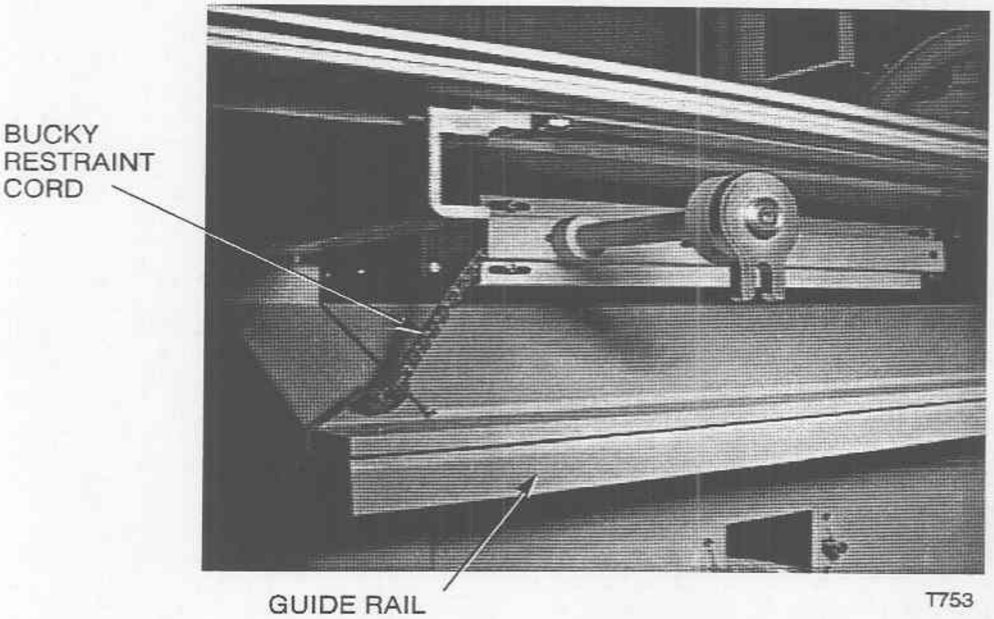


FIGURE 6-13 BUCKY RESTRAINT CORD

28. At the front of the bucky, loosen the locking device and move to the left as shown in **Figure 6-14**.

29. Secure the locking device in place.

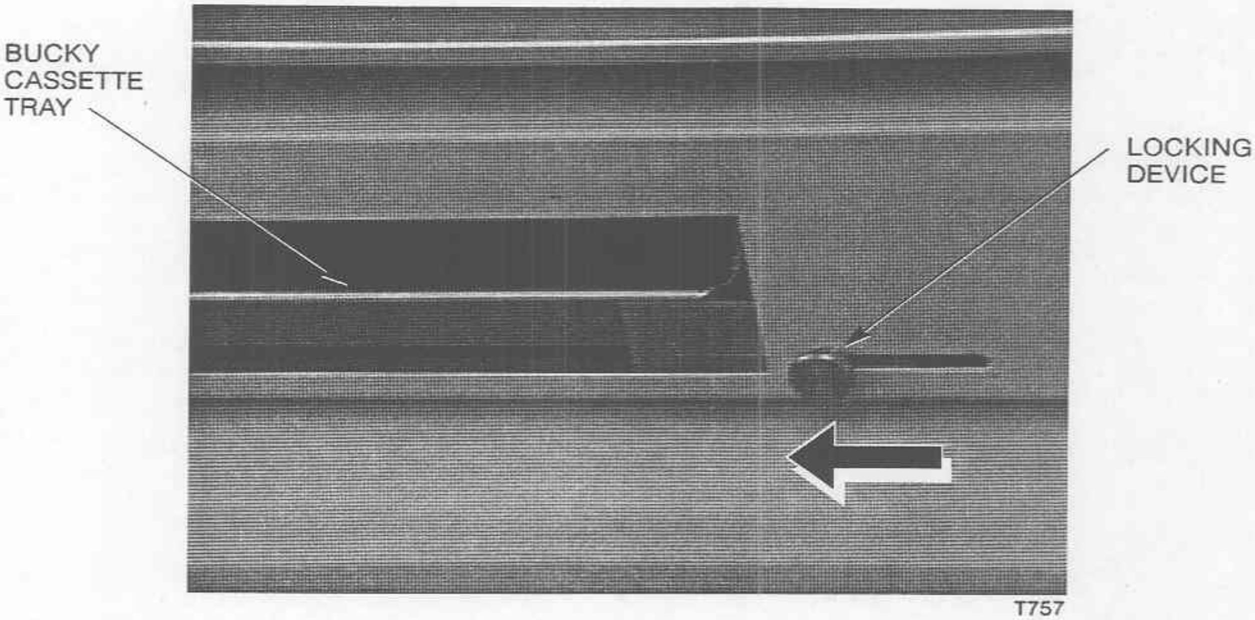

BUCKY
CASSETTE
TRAY
LOCKING
DEVICE
T757

FIGURE 6-14 SECURING BUCKY CASSETTE TRAY

END OF MANUAL

PICKER

X-ray Technical Publications, 595 Miner Road, Cleveland, Ohio 44143